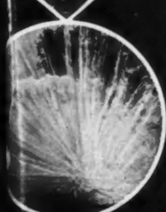
CHEMISTRY



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Metals for the Future

➤ NOT SINCE the time of Tubal-Cain, legendary instructor of artificers in bronze and iron, has there been as much excitement about metals as there is today. Metals are strong, most of them are heavy, many are heat-resistant, and man is beginning to know how to handle them. They seem destined to be the materials of the future.

And there are so many of them! Out of the 98 known elements, all but about 20 are classed as having metallic properties. Non-metals appear only among the lighter elements and the anomalous inert gases and halogens. Metals occur as constituents of practically all rocks. Mountainous regions abound in minerals which often contain metals seldom seen in metallic form. The clue to which metals are familiar lies not at all in the abundance of the element, but rather in its chemical combining power.

Copper, gold and silver, the metals too "noble" to mix with "common dirt," were man's only metallic discoveries for a long time. They were always rare. Our present-day store of them is greater than that of the ancients, because it includes most of the metal worked by man before the dawn of history and throughout all the following centuries.

Crude smelting operations gave man the other four metals of antiquity, tin, lead, iron and mercury. The chemical curiosity of Arabs added a few more during the Middle Ages, notably zinc, arsenic and bismuth. Methods of extracting metal from ore did not improve much until electricity increased the number of possible approaches to the problem.

Not until the present century have chemists really begun to explore on a large scale the metallic wealth locked up in the miscellaneous minerals unrecognized by Tubal Cain.

Aluminum was the first of the modern metals. Several of the great names of chemistry are associated with its preparation as a scientific curiosity: Oersted, Wöhler and Deville. They reacted aluminum compounds with chlorine, then introduced some other metal to take the chlorine away. This is essentially the method now used for titanium. Hall's process for obtaining aluminum by electrolysis of bauxite (alumina) with cryolite (sodium aluminum fluoride) depends upon unique properties of both aluminum and its fluorine compound. So far a corresponding process for titanium does not seem to be known.

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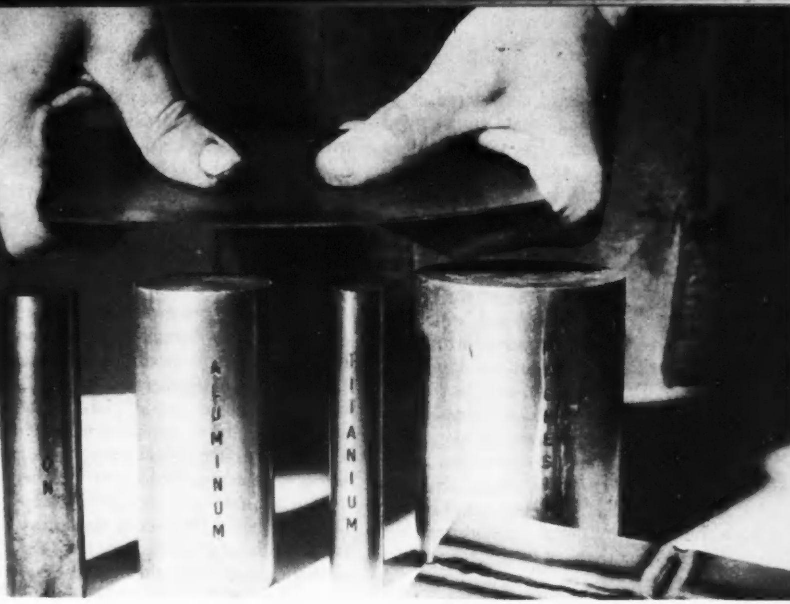


—Photo by Fremont Davis

➤ FOUR METAL BARS *of equal tensile strength are shown, the diameters of the bars giving striking evidence of titanium's superiority in this property over iron, which is heavier, and the two light-weight metals, aluminum and magnesium. Welds appear as a cross on the titanium sheet on the table. A mechanic tries to bend a thin sheet of titanium, illustrating another valuable property of the unfamiliar metal.*

Titanium Is Tough

by HELEN M. DAVIS

➤ TITANIUM, the metal with an important future, is awaiting the genius who can put it into mass production.

Several companies are already turning the new metal out in considerable quantities, but it is refined in batches by a costly process. Its manufacturers wish they could adopt a more direct method to get the metal out of its ore and protect it during the process.

Once in ingot form, titanium metal can be handled by the conventional methods used for special steels and the harder alloys. In between ore and ingot, titanium is a very energetic chemical. Manufacturers have difficulty at this stage outwitting its reactive tendencies.

The chief ore of titanium is ilmenite, a black, magnetic, metallic-looking mineral classed chemically as ferrous titanate. Exasperated metallur-

gists have for years considered it as merely something that ruins good magnetic iron ore. Even a little of it makes smelting too difficult by the methods commonly used to obtain iron.

Unlike some elements in wide demand, titanium is plentiful. There is said to be more of it in the world than of all the copper, lead, zinc, tin, gold, silver, platinum, tantalum, beryllium, sodium and uranium added together. Two circumstances have kept it out of use up to now. One is the difficulty of working the ore. The other is the small concentration of its widely distributed deposits. No big veins of titanium minerals are known, although, now that prospectors are hunting for them, it is not impossible that some may be located.

Most of the titanium deposits now being worked are on shorelines, present-day or fossil. Such deposits are similar to placer gold. The heavy mineral is washed down-stream and concentrated on the beach by the cross-currents of rivers and the tides.

Heavy black sand from the beaches of southern India is being imported to America by the Du Pont Company, because this is the richest ilmenite they have so far found. Du Pont is also working a sand deposit in Florida, using the mining skill of the Humphreys Gold Corporation of Denver, Colorado. Methods very similar to the hydraulic methods of gold mining are in operation there.

A suction dredge pulls the sand aboard a barge, known as a "scrubber," where organic material is removed and the black mineral is separated from the white sand in a "wet-mill." The water necessary for this operation forms an artificial lake on which the barge floats. It has become a "travelling lake," because the dredge picks up the sand in front, removes the mineral, and dumps the sand back over the stern. Barge and lake progress together over the titanium-bearing deposit.

Besides ilmenite, the iron compound, titanium has a few other ores. The most important of these are the two crystalline forms of titanium dioxide, known as rutile and anatase. Chemically they are practically the same, but their physical properties are different because the atoms of their crystals are arranged in different ways. Chemists have discovered that titanium dioxide crystallized in the form of rutile is one of the whitest substances known.

Titanium Pigment

The fact that this white substance would make good paint was discovered, legend says, in 1908 in the laboratory of the Titanium Pigment Corporation at Niagara Falls. The pigment made there was used in manufacturing false teeth. The company's French chemist, Auguste J. Rossi, was eating lunch at his laboratory work-bench when he spilled some of the olive oil for his salad onto some of the titanium dioxide with which he was working. Not every pigment will work up with oil into the consistency necessary for paint. Rossi noticed that his impromptu paint had good spreading and covering power. Twenty years, however, went by before all the conditions were right for manufacturing titanium dioxide paint, and then it was done by another company.

Du Pont got into production of titanium metal because it had been working the minerals to obtain titanium dioxide for use as a pigment. Titanium dioxide began to be added to paint about 1920, but really made its mark when combined with synthetic oils, about 1928.

Previous to that time, a few people had been interested in titanium as a metal. There were two main uses for which unusual metals were being tried out early in the 1900's. These were for electric light filaments and for additives to make tool steel stronger and tougher. Both of these uses were tried for titanium. The second found some application for titanium's great combining power. In the form of ferro-titanium, a small amount added to molten iron would take out certain impurities, notably gases, by combining with them in a form that could be separated from the resulting steel.

Titanium becamse known to the metals industries as a "scavenger," and the Titanium Alloy Manufacturing Co. was formed at Niagara Falls to produce ferro-titanium for this purpose. Little was known about the true properties of the pure metal.

Discovery of Titanium

Discovery of the element dates back to 1791, when an account appeared in *Crell's Annalen* of a new black mineral, resembling gunpowder, which had been found in Menachan parish in Cornwall by Rev. William Gregor. Mr. Gregor was an English clergyman who was known to Berzelius and other contemporaries as a famous mineralogist. He recognized not only that he had found a new mineral but also that it probably contained "a new metallic substance." He contributed the name "menachanite," which still appears in text books as an alternative term for the mineral, ilmenite. The name for the metal was given by Klaproth, who discovered it independently in rutile from Hungary in 1795.

Throughout the 19th century chemists who were outstanding in the analysis of minerals took their turns at trying to isolate the metal titanium, but were defeated by the fact that titanium nitride forms readily under conditions that would yield the metallic form of many other elements.

Nilson and Petterson, Swedish chemists, in 1887 pioneered the process by which titanium metal is obtained today. They first changed the titanium ore into the form of the tetrachloride, then reacted that compound with a metal which would replace titanium. They used sodium, carrying out the reaction in an air-tight steel cylinder.

In 1906 Dr. Matthew A. Hunter, now Dean of Faculty at Rensselaer Polytechnic Institute, was working for General Electric Co. on the problem of metal filaments for incandescent electric light bulbs. He isolated some titanium by his improvement over the process Nilson and Pettersson had used. Hunter's reaction of sodium with titanium tetrach'oride was carried out in a steel bomb capable of withstanding high pressure. He got titanium with only a few hundredths of a percent of impurities, but the hardness and brittleness of the samples he obtained varied unpredictably. And he learned that titanium is not suitable for electric light filaments.

The Titanium Alloy Manufacturing Co. repeated Hunter's experiment and

produced some metallic titanium which was exhibited as a chemical curiosity in 1919.

Meantime another halogen compound of titanium, the iodide, had been used to produce the metal in the purest form known. The properties of this extra pure metal seem so promising that attempts to improve the purity of the yield from other processes seem worthwhile. In the iodide process, hot iodine vapor attacks crude titanium metal inside an evacuated glass bulb, containing a filament, similar to an electric light bulb. Titanium iodide then breaks up and crystals of pure titanium form on the hair-pin-shaped hot filament. Fantastically expensive as this method is for anything but a research sample, it proves that titanium's brittleness comes from the impurities it absorbs.

Kroll Process

This much was known about titanium when Dr. Wilhelm Kroll, working for the German firm of Siemens and Halske, in 1932 modified the titanium tetrachloride process by substituting magnesium for sodium as the metal to release titanium.

Leaving Nazi Germany, Kroll is now at the U. S. Bureau of Mines. Since 1943 the Bureau has had in development the commercial-scale process, based on Kroll's method, by which titanium in quantity is now produced. The secret of such success as has been achieved in handling the metal is to blanket molten titanium with argon or another of the inert gases. Both oxygen and nitrogen must be kept away, for titanium, under the conditions in which it is produced, will burn in either. Another problem is that molten titanium will dissolve any melting pot made of a refractory oxide. Graphite, however, can be used.

It might seem that such a chemically active metal would be dangerous to have around after it has been reduced from its ores. By a fortunate coincidence, titanium, like aluminum, acquires a surface coating of oxide which prevents further reactions. So resistant to corrosion is this surface that manufacturers are looking forward to substituting titanium for iron in locations where rust is a problem.

U. S. Navy Interested

The interest of the U. S. Navy in titanium springs primarily from this resistance to corrosion. Salt sea water is a constant menace on shipboard. Titanium resists its action better than any of the metals the navy uses at the present time. As an additional advantage, titanium is lighter than iron. It is not as light as aluminum, but it exceeds both these metals in strength, as is shown strikingly by the photograph at the head of this article. The slender rod of titanium shown there is equal in strength to each of the thicker rods of the other three metals, iron, aluminum and magnesium.

With interesting possibilities for its use and a practical, even though complicated, method of producing the new metal, the U. S. Bureau of Mines began pilot plant operation to manufacture it, by the modified Kroll process, in 1946. The Du Pont Company claims first commercial production in 1948. They use the same process, with improvements their research teams have been able to work out with experience. Manufacturing titanium as far as the spongy stage

which results from its chemical isolation, Du Pont then turns the metal over to other companies for forming into conventional ingots, sheets, and other forms in which metal users expect to get the product.

Other companies interested in metals are now embarked on the titanium venture. National Lead Co., long interested in paint, has joined with Allegheny Ludlum Steel Corporation to form Titanium Metals, which is building a huge new plant at Henderson, Nevada, for production of titanium metal. It will rival Du Pont as a producer.

Metal Hydrides, of Beverly, Mass., is producing the metal in powdered form, by reaction of titanium dioxide with calcium hydride. Dominion Magnesium, Ltd., at Haley, Ontario, is making titanium powder by a similar process.

Quebec Iron and Titanium Corporation, formed by Kennecott Copper and New Jersey Zinc Corporations, has begun operations at Lac Tio in Quebec to produce both iron and titanium from large ilmenite deposits recently located there by magnetic surveys.

In Cleveland, Ohio, Horizons Titanium Corporation is building a pilot plant to produce titanium by a new process developed by its chemist, Eugene Wainer. The process is believed to be electrolytic, the type of reduction which cuts costs. Whether titanium's problems can be solved for such a process remains to be seen.

One of the two processes now in use by Du Pont may, in the opinion of that company, hold the key to continuous melting and casting of titanium. In it ingots can be formed continuously from molten metal, then cut to suitable lengths. Du Pont's furnaces of this type are now producing ingots as large as 1200 pounds.

At Columbia University, in New York City, Arthur Kerbicek, a graduate student, believes he has an electrolytic process which will help in the present objective of cutting titanium production costs.

While watching the development of useful titanium, the comparison with aluminum inevitably comes to mind. It, too, went through a long history as a chemical curiosity, kept from large-scale production by lack of a good method for continuous production. The problem was solved in the case of aluminum by electrolytic decomposition of fluoride ore. Titanium, too, occurs in combination with fluorine, and Berzelius first isolated the metal from such an ore. He used sodium to displace titanium from potassium fluotitanate. Many are wondering whether the history of aluminum will be repeated in this instance. Others no doubt believe they are having trouble enough already with titanium's problems, without adding those of fluorine.

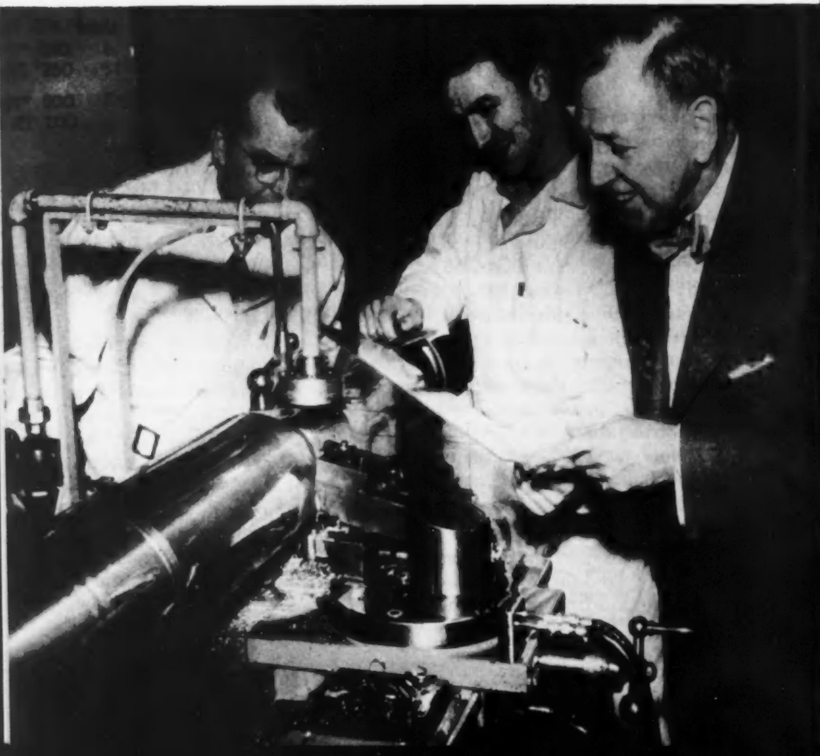
Whatever the results turn out to be, cheaper titanium is the big problem at the moment, and many keen research teams are working on it. Solid gains already achieved are, first, a commercial-scale method which, though not ideal, is turning out titanium in ton lots, and, second, enough mastery of titanium's properties to get rid of the factors that make it brittle. "Ductile titanium" is already a trade term.

The working of titanium is another problem, but nothing like its production. Titanium is hard and tough, and promises to give rise to alloys even harder and tougher. Metal workers are already pitting their skill against such materials.

One of the uses projected for titanium is in heat-resistant alloys. This is still in the future, but designers believe such alloys are possible, and that they will be used for jet-powered rockets. It is no secret that such craft are limited today by the melting points of materials to build them. If titanium alloys can stand up to the required temperatures, the sky is no longer the limit, and rockets may take off for those space trips the dreamers talk about.

➤ THE INVENTOR *of Hi-Jet, R. J. S. Pigott (right), watches through a transparent shield while George Wright, machinist (center), and Paul Busang, engineer (left), adjust the jet of cutting oil which speeds the operation of the machine lathe. This improvement in machining metal allows tough titanium to be worked comparably to softer metals.* ➤

—Gulf Oil Corp. Photo



Cutting Oil Invention
Speeds Work, Saves Tools

Oil Speeds Metal Cutting

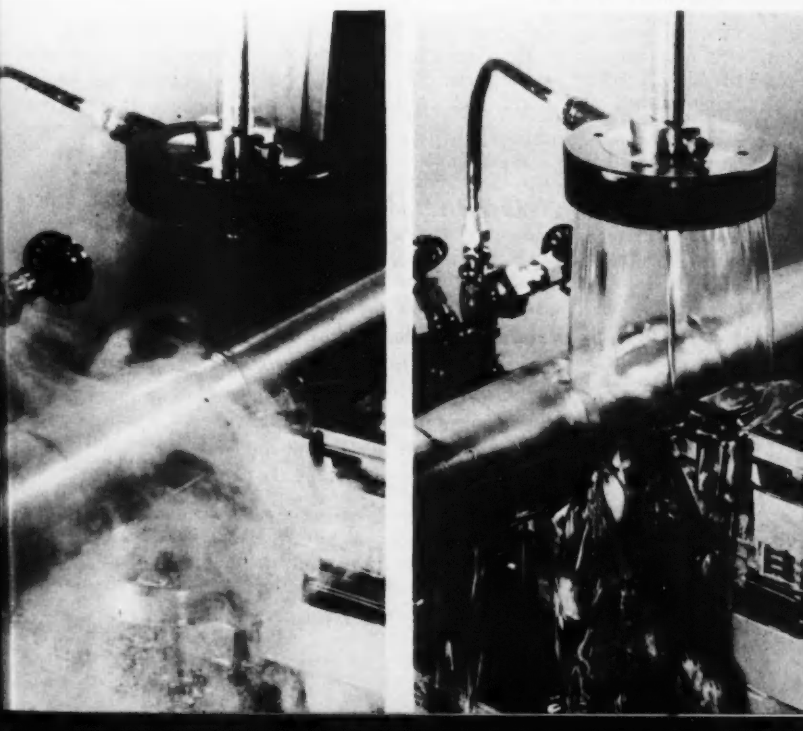
➤ FASTER cutting of difficult metals, more economical cutting of softer metals and cutting of the new metal, titanium, at any reasonable speed are all forecast by the new machining process announced by the Gulf Oil Corporation.

The new way of jet oiling while cutting metal can quintuple metal machining production for defense and industry. It was invented by R. J. S. Pigott, director of engineering research of the Gulf Research and Development Co. in Pittsburgh.

Squirting a fine jet of a specially-developed cutting oil under 400 pounds per square inch pressure from below and directly upon the cutting point,

➤ VAPOR RISES *(left) as the heat of friction boils away the Hi-Jet cutting oil spread as a thin film over the surface of the metal being cut. A shower-bath (right) of the cutting oil encloses the cutting point in the complete operation, absorbing the vapor and cooling the metal and the cutting tool.*

—Gulf Oil Corp. Photo



the new method lubricates as it cuts. This allows the machinist to cut faster at the same time that the oil cools the metal and lengthens the life of the cutting tool.

The new process, marketed under the name Hi-Jet, will be developed by Thompson Products, Inc., of Cleveland, Ohio. They will devise ways of applying the new process to hard, tough steels and alloys, with a saving of time, power and scarce materials.

Wonder that direct lubrication of the cutting point in metal working had not been applied 50 years ago was expressed by Mr. Pigott. He is a mechanical engineer, a graduate of Columbia University and president this year of the American Society of Mechanical Engineers. Older processes used in cutting metals flood the piece of metal being cut with so-called cutting oil, according to Mr. Pigott, but the oil is deflected by the metal chip being pushed up by the tool as it cuts. The cut surface comes out dry, and the only effect of the oil is to carry away some of the heat developed by the friction of the tool.

In the Hit-Jet process, by installing a compression pump and from one to five jets under the cutting point on the machine, Mr. Pigott explains, lubrication reaches the exact point where this friction develops the heat. This allows faster cutting, longer wear for the machine tools and the possibility of cutting metals too tough for present practice. Additional cooling is provided in the design of the new apparatus by a thin curtain of the same oil dropped from above the tool, so that all cuts are made within a small volume of space surrounded by cooling oil. Hi- Jet oil can also be used on the same machine for lubrication and for a hydraulic fluid for moving parts, which allows re-use of the oil and fewer kinds of oil to be stocked by the shop.

On the Back Cover

➤ Lubrication *while cutting allows tough metals like titanium to be machined at reasonable speed, and ordinary machining to be done faster with longer life for the tools. The small jet of oil playing from below onto the cutting surface is the lubricant in the Hi-Jet process just announced by the Gulf Oil Corporation.*

Aurin Tricarboxylic Acid Fixes Beryllium Salts

Beryllium Poison Antidote Found

➤ THE FIRST successful antidote for beryllium poisoning has been reported to the American Chemical Society by Dr. Jack Schubert of the Argonne National Laboratory.

The metal beryllium, formerly used in fluorescent lamps and now employed as a source of radioactivity in the atomic energy program, has only recently been recognized as the cause of an insidious, slowly-developing disease, Dr. Schubert told the Society's Chicago Section at an all-day chemical conference held at the Illinois Institute of Technology.

A compound known as ATA has been found to be a nearly perfect antidote for otherwise fatal doses of beryllium compounds in animal experiments carried out by Dr. Schubert, Marcia R. White, Asher J. Finkel, and Arthur Lindenbaum of the Argonne Laboratory. ATA also gives protection when administered to animals before exposure to beryllium.

A light weight, durable metal, beryllium is used with radium as a source of radioactivity and is under investigation as a possible construction material for atomic piles.

Poisoning results from the presence of small amounts of beryllium metal or beryllium compounds in the body, Dr. Schubert explained. Inhaled beryllium induces widespread damage in the lungs. At present no successful cure for the disease is known although marked temporary improvement in many patients has been obtained by the use of the wonder drug ACTH.

It is hoped that ATA or similar compounds, alone or in combination with ACTH will be effective for the treatment of the disease in people. It must be emphasized that the experiments and results reported were conducted solely with animals and considerable testing is still needed before ATA is tried on cases of beryllium poisoning in people.

A frontal attack was made on the problem of treating beryllium poisoning by attempting to remove the beryllium itself from the body of experimental animals previously injected with fatal doses of beryllium compounds. It was learned that it is practically impossible to influence the rate of elimination of beryllium from the body.

Consequently it was decided that the tissue damage induced by beryllium might be minimized if the beryllium was inactivated in the body by combination with some non poisonous substance. The search for such a substance was guided by known chemical principles concerning the type of chemical structure which reacts with a metal like beryllium. Such reasoning led to a substance used by chemists for many years for the chemical analysis and detection of beryllium and other metals. This substance, known chemically as aurin tricarboxylic acid (ATA), forms a red compound with beryllium salts.

This is the same kind of reaction by which a metallic salt fixes a dye to cloth.

Theoretically ATA seemed to meet all the requirements of the substance needed to counteract beryllium poisoning. When injected into the bloodstream it is readily distributed to the various organs, it is relatively non-toxic, and is capable of reacting with beryllium under the special conditions present in the body.

In order to prove conclusively that ATA was effective, because it actually combined with beryllium, several experiments were performed. First, it was found that ATA is capable of reversing the damage induced by beryllium in certain enzymes—substances essential for body metabolism. Furthermore, the amount of ATA needed to reverse the damage is just about the amount known to react with beryllium in test tube chemical experiments.

The research also showed that other compounds, similar in structure to ATA but lacking certain chemical groups, are ineffective against beryllium poisoning. This result proved that these groups are needed to inactivate beryllium. Finally, the actual distribution in the bodies of experimental animals of radioactive beryllium and of ATA labeled with radioactive carbon was studied. The results prove that ATA gives protection against beryllium poisoning when the injected beryllium is in the bloodstream or is already deposited in certain susceptible organs such as the liver, and that ATA does not cause any change in the distribution of beryllium in the body.

All of these results are consistent with the theory that ATA inactivates beryllium in the body by forming an inactive and non-toxic compound.

Geiger Counter Diagnoses Thyroid

➤ A SUPER-SENSITIVE Geiger counter known as the beta scintillation counter has been used by Los Angeles doctors in diagnosing hard-to-find thryroid diseases in more than 100 patients.

Dr. Thomas F. Barrett, clinical professor of medicine at U.C.L.A. and chief of professional services at the Veterans Administration General Medical and Surgical Hospital, reports this method picks up many thyroid conditions missed by other diagnostic means.

The machine, developed by Dr. Benedict Cassin of the U.C.L.A. Atomic Energy Project in 1949, has been used for the past four months.

A patient is given a small dose of radioactive iodine, about one to two microcuries. This very safe dose is about one-half to one-fourth the amount of radiation a person gets during a normal chest X-ray.

Since the thyroid acts as a scavenger for the iodine, a "scintogram" of the gland can be taken by recording the radiation given off by the iodine in the gland. For instance, if cancer is present, it will record as a white spot on the scintogram.

Radio Atoms Picture Happenings Inside Cells

Radiations Probe Deeper Into Cells

➤ EXPLODING atoms can now be used to tell what happens inside living cells. Radioactive materials have heretofore allowed scientists to differentiate between the portions of living matter that are larger than the minute cells and their fine structure.

Dr. S. R. Pelc of London's Hammersmith Hospital told the International Biology Conference held recently under the auspices of Brookhaven National Laboratory of refined techniques in autoradiographic studies.

He is applying radioisotopes to studying the growth and action of chromosomes, the minute particles within the cells that contain the material that passes on heredity.

Shoot Neutrons at Vitamin

➤ THE ANTI-PERNICIOUS anemia vitamin B-12 has been made radioactive by neutron bombardment in the research reactor at Brookhaven.

As a result, medical scientists should have plenty of the radioactive vitamin for tracer studies in research to learn how the vitamin helps fight pernicious anemia.

Each molecule of vitamin B-12 crystals contains an atom of cobalt 59, the naturally occurring form of cobalt. When the vitamin crystals are irradiated by neutrons in the reactor, the cobalt is changed to cobalt 60, which is radioactive.

Heretofore the only method of making the vitamin radioactive was to feed cobalt 60 atoms to the mold from which the vitamin is produced commercially by fermentation.

The reactor method of producing radioactive B-12 has been described by Dr. R. Christian Anderson and Yvette J. Delabarre of Brookhaven in a report to the Journal of the American Chemical Society.

Food Moving in Sugar Cane

➤ THROUGH the use of radioactive carbon dioxide, scientists at the Hawaiian Sugar Planters' Association Experiment Station have been able to trace the movement of food through sugarcane plants. The radioactive material was fed to a single leaf and its progress through the plant was checked with Geiger counters.

Within 20 hours after feeding, food manufactured by this leaf was found to have moved to blades in other stalks of the plant. In 44 hours, 94% of the material had left the blade from which it had originated. All but three per cent had moved out within eight days.

Although the greatest amount of material had moved to the stalk immediately below the joint to which the test blade was attached, some had found its way to old joints. This disproves the theory that active storage takes place only in joints to which leaves are attached.

It was also found that different stalks within the plant received varying amounts of the food manufac-

tured in the test leaf. The variation was not related to the size of the stalk, indicating, according to the experimenters, that there must be some internal physiological factors determining distribution.

On the basis of these experiments, it is estimated that the minimum rate of movement of food within the plant is about $1\frac{1}{2}$ feet per hour.

Experimentation with the radioactive carbon, obtained from Oak Ridge, was begun several years ago. Earlier tests proved that green leaves can form cane sugar by adding together the two simple sugars, glucose and fructose.

Poisoning of Living Plants

➤ WHETHER atomic fission products can be taken into plants in such quantities as to contaminate them is being studied by the University of California College of Agriculture.

Two fission products, cesium and strontium, though not essential to plant growth, were found to be absorbed in plant roots in laboratory studies by Dr. Roy Overstreet, professor of soil chemistry, and Dr. Louis Jacobson, assistant professor of plant biochemistry.

These tests are a part of a study to find out exactly what influences the intake of minerals, especially the essential ones, in plants. The problem is aimed at producing a favorable environment in the soil for mineral absorption.

For two years Dr. Overstreet and Dr. Jacobson worked to perfect a stable culture process to study mineral absorption by plants. Roots of barley plants grown in the dark were found best suited to this study. The roots are put in culture solutions containing various radioactive mineral salts. In this way rate and amount of mineral absorption can be determined.

Potassium, phosphates, and bromides were found to be absorbed more rapidly when certain amounts of calcium were added. There was also found a competition between the hydrogen in acids and the minerals to be taken into the plant. The reasons for this have not been determined, but future experiments may answer the questions of ion absorption. This work is being done partly under a grant from the Atomic Energy Commission.

Star Light Changed by Cosmic Iron

➤ LIGHT from many of the stars in the constellation of Aquila, the eagle, vibrates slightly more in one direction than in another.

Light from at least two-thirds of the 300 faint stars within a half square degree area in Aquila is polarized to at least 1.5%, Joseph L. Gossner of the U. S. Naval Observatory told members of the American Astronomical Society recently.

These stars are so far from the earth that light which started from them some 1,000 or more years ago is just now reaching our planet. At some time in its journey the light passed through a dust cloud containing many iron particles which polarized it. Light from stars in this constellation that are very close to us has not been polarized.

While Prospectors Search By-Product U Is Recovered

World Combed for New Uranium

➤ DISCOVERY of uranium, the atomic bomb element, in some of the other American Republics in Central and South America is likely when relatively unexplored areas are prospected for this metal.

This was indicated in a U.S. Atomic Energy Commission statement prepared for delivery before the American Institute of Mining and Metallurgical Engineers meeting recently at Mexico City.

Uranium production in the United States has increased greatly as the result of a three-year AEC program, it was indicated. There are probably more individual prospectors looking for uranium than for any other metal. Large mining companies are making substantial investments in mines and plants. Many small operators are mining ore. Hundreds of thousands of feet of exploratory drilling are sunk each year. There are also airborne radiometric surveys.

Exploration and development in Canada has been equally successful, and South Africa, Australia and a number of other countries soon will be on the list of important uranium producers.

U. S. Uranium Reports Opened

➤ URANIUM prospectors will now have the chance to study reports previously not available on the atomic metal, the Atomic Energy Commission and the U. S. Geological Survey have announced jointly.

The reports cover exploration work done by AEC and the Geological Survey in Arizona, Colorado, Montana, New Mexico and Utah. They can be read at nearly 50 different libraries, Commission offices and Survey offices scattered throughout the country. Information in the reports is for prospectors, mining companies and other persons or organizations interested in looking for and developing uranium deposits.

Results of mineralogical studies are also covered in some of the reports.

Uranium From Fertilizer

➤ THE FERTILIZER industry can make an important and continuing contribution to our domestic supply of uranium, an Atomic Energy Commission official has said.

For many years farmers have been spreading on their fields fertilizers made from phosphate rocks. These fertilizers contain small amounts of uranium, which neither help nor hamper plants, test have shown. Now the AEC is proposing to recover this uranium, add it to our stockpile of the valuable raw material.

The first production plant to recover uranium from phosphoric acid is now under construction by the Blockson Chemical Company at Joliet, Ill., Sheldon P. Wimpfen of the raw materials division told members of the National Fertilizer Association.

Although the amount of uranium per ton of phosphate rock is very

small, such large tonnages are mined annually to make fertilizer that this source of uranium has been thoroughly investigated by the AEC. Two processes look most promising for recovering the uranium: from wet-process phosphoric acid and from solutions made in the course of manufacturing phosphate fertilizers by acidulation with nitric acid.

New Chemical Treatment Saves Elms

➤ DUTCH elm disease, that once threatened doom to the popular shade tree, can be prevented in seedlings in all but a few cases by a newly developed chemical treatment.

Dr. A. E. Dimond, chief plant pathologist of the Connecticut Agricultural Experiment Station at New Haven, reported that the chemical, 2-methylcarboxymercaptobenzothiazole, has given better results against the dread disease than any other method now being used.

The compound acts from the inside of the tree, being absorbed by the elm to attack the disease-causing fungus at its source. It can, however, be sprayed on the tree, a method much less cumbersome and expensive than applying a compound to the soil under pressure as is required for the two chemicals previously most effective against the disease. Many city trees cannot receive soil treatments because they are surrounded by pavement.

Seedling elms treated with the new chemical and then inoculated with the Dutch elm disease fungus showed only five per cent disease at the end of the season. Untreated elms inoculated in the same way were 45% diseased at the end of the same period, while those treated with one of the previously most effective chemicals were 12% diseased.

The compound is not yet on the market and still has to pass a few more seasons of extensive testing, Dr. Dimond told a recent meeting of the American Phytopathological Society.

Since introduced into this country in 1930, the Dutch elm disease has destroyed thousands of priceless elms. It has spread as far west as Colorado and as far south as Virginia.

Besides the chemical treatment of the tree from the inside out, known as chemotherapy, scientists battle to save the elm by halting the insects that spread the Dutch elm disease and another serious threat to the shade tree, phloem necrosis. To fight the insects carrying the twin blights, high-pressure, high-dosage DDT sprays are used. When the blast of chemical mist is enough to soak completely the foliage of a tree, the job of protection is about 40% done, scientists have found.

One hope for the future are strains of disease-resistant elms being studied by the U. S. Department of Agriculture. But worried scientists are concentrating on ways to save the present generation of elms, knowing that a new generation of hardier elms may come too late.

England has established a research plant designed to abstract chemicals from seaweed.

First Law States Mass and Energy, Second Law States Work Balance

Practical Thermodynamics

➤ THERMODYNAMICS has usually been presented from the classical approach as the philosophy of energy, according to George G. Brown and Cedomir M. Sliepcevich of the University of Michigan, speaking before the recent meeting of the American Institute of Chemical Engineers. In an attempt to streamline this philosophy and emphasize the practical aspects, new forms of expression were brought in by the speakers. These included chemical, electrical, compression, surface, gravitational and centrifugal effects.

The temperature difference between two objects is a measure of the potential available for overcoming resistance to energy transfer between those two bodies. This type of energy transfer is usually referred to as heat, but after the energy has been transferred, it becomes part of the internal energy, no longer identifiable as heat. Mechanical means could also be used to cause a transfer of internal energy to a body.

This extensive property is known as entropy and bears the same relationship to thermal effects as weight does to potential energy effects. The product of extensive and intensive energy effects represents increase in energy content due to thermal effects.

The first law of Thermodynamics states that the accumulation of energy and mass in a system is equal to the energy and mass brought into the system minus the energy and mass taken out of the system. It it not important which effects are included as internal energy but it is important that a definite understanding be made as to what is included. No discrimination need be made, either, between energy and mass, within the system.

The second law of Thermodynamics is a work balance, just as the first law is an energy and material balance. To an engineer, the second law is the more important. For the maximum quantity of work to be obtained, it is necessary that the lost work equal zero. Under isothermal conditions this maximum work becomes the reversable work. If there is not energy available to overcome the resistance to change, no work will take place.

Availability is the key to the use of the second law, when conditions are not isothermal. Availability is an expression of the difference in work between a system and its surroundings and availability balance allows the determination of the maximum work for a non-isothermal condition.

The use of the metal titanium instead of steel in the structural parts of big airplanes could save up to a ton in weight without decreasing strength.

High-grade iron ore of the Mesabi area, Minnesota, from which most American steel has been made for several decades, is about 51% iron; taconite from the same region is about 25% iron.

Radioactive Material
Studied in Laboratories

Living With Atomic Energy

➤ A COMBINATION of horizontal and vertical holes through the three-foot concrete wall behind which are radioactive materials provides a safe way in which the deadly objects may be studied by microscope, and photographed. It is used at the Knolls Atomic Power Laboratory which is operated for the government by General Electric.

Horizontal holes enter the wall on each side but at different levels. They are connected at their inner ends with a vertical hole in which a periscope with mirrors is fixed. Two such combinations are provided. Strong light goes through one, assisted by lenses, illuminates the radioactive material and brings the image out through the other into a microscope for examination or photographing.

This arrangement permits light for illumination to pass through the wall, and the light given the image to return, but blocks the passage of the dangerous radiation from the radioactive material under study. Handling materials within the chamber and bringing them into focus for study are done by remote control, permitting researchers to work in complete safety.

The entire assembly of a special microscope for examining the structure of metals, the camera, periscopes and illuminating system was worked out jointly by scientists and engineers of General Electric and the American Optical Company's Buffalo division.

Exploding Atoms in Industry

➤ A LARGE-SCALE demand for exploding atoms, by-products of atom bomb production, exists in industry, but their use will depend primarily on the price at which they are available. They would give industry certain types of radiation at less cost or in more convenient forms than presently available sources.

This was the conclusion of a survey of industrial uses of radioactive fission products conducted for the U. S. Atomic Energy Commission by Stanford Research Institute. Although many technical and economic problems must be solved before the millions of curies of radioactive wastes now stored at AEC installations can be used, refinement and concentration would make them suitable for industrial purposes, the survey showed.

Present commercially possible uses for such products include the activation of phosphors for self-luminescent signs and markers and in process control instruments, such as those measuring the thickness of materials by radiation penetration.

Possible future uses for fission products, where two to five years may be required for development, include cold sterilization of drugs and food and portable low-level power sources. The report states that food sterilization without heat offers many attractive potential markets for fission products, primarily because of the possibility of obtaining unique final products that

cannot be obtained economically by other known means. The largest market groups include meats, fresh fruits, fresh vegetables, beverages and miscellaneous perishable food products.

Atomic Energy Laboratory Planned for Europe

➤WHILE international co-operation on atomic energy has not been achieved, a movement is under way to establish a laboratory for nuclear physics that would be a joint European effort.

For several years, a large research laboratory with a staff of 300 and a million dollar a year budget has been in the process of formation by UNESCO (United Nations Educational Scientific and Cultural Organization).

Equipped with a powerful accelerator of particles, called a cosmotron, that would give energies comparable to cosmic rays, this new laboratory would be a regional institution serving European countries. Many nations in Europe cannot have research laboratories of their own and they are considering pooling some of their resources to provide a joint investigational effort.

Belgium, France and Italy have already offered to help finance the proposed nuclear physics laboratory. In addition, Sweden, Belgium, Norway, Great Britain, the Netherlands and Switzerland have participated in the discussion to lay the foundation of the new organization.

The new European Nuclear Physics Laboratory would be devoted to nonsecret and non-military investigations that will be of value to all peoples of the world, especially those of Europe.

To establish the laboratory $20,000,000 to $25,000,000 would be needed, $12,000,000 of which would be needed to build the giant accelerator of 6 billion electron volt energy, similar to the biggest one now under construction at Berkeley, Calif.

To support the European Nuclear Physics Laboratory, the participating nations would need to contribute about twice as much anually as they allot to UNESCO itself.

Those in Paris planning the new laboratory argue that the powerful particle accelerator is necessary for any program of investigation of the constitution of matter and fundamental research in chemistry, biology, medicine and the other sciences.

Research workers from different countries would work together, using the same apparatus, helping each other with their problems and the bonds thus established would grow into a permanent collaboration between scientific institutions and industries of the participating countries. Specialists, of whom European countries are very short, would be trained. The construction and the activities of the new laboratory would stimulate industries in the participating countries.

The initiative for the inaguration of the new combined laboratory will need to come from the countries that will participate. UNESCO in Paris is acting as a stimulating organization and the laboratory when established would be an independent international organization.

Aluminum owes much of its usefulness to the oxidized layer that forms on its surface which stops further corrosion.

New Knowledge of Earth Obtained From Recent Finds

Geologists Find Mineral Surprises

➤ A NEW deep sea fishing record has been set by scientists. Their prize came from the ocean floor, three miles down.

The find — probably the largest rock ever dragged up from a three-mile depth — is now being examined at the University of California's Scripps Institution of Oceanography, La Jolla, Calif.

Like many other objects — rocks, whale bones and sharks' teeth — dredged up from the ocean's floor, this 100-pound mass is covered with manganese dioxide. Manganese, a metal used in hardening steel, is known to exist on the bottom of all oceans, and in the dioxide form it coats ocean objects.

By finding out what lies underneath the chemical coating, scientists may get new information on the age of the Pacific, for manganese dioxide does not accumulate on rocks on land.

The prize find was brought up only by chance. Oceanographers on the research vessel Horizon had been using a new, more efficient way of telling when their hydrographic wire had reached bottom. The new method — breaking a glass ball at the end of the wire, then picking up the sound waves it sets up on the ship's hydrophones—promises to become standard for scientific cruises. One time when it did not work, extra cable was paid out and when this was hauled in, there was the rock, covered with manganese dioxide.

Rocks and Magnetism

➤ A LINK between the changes that occur in rocks of the earth's crust and puzzling variations in the magnetic field of the earth in some regions is suggested by Dr. John D. Weaver, of Columbia University's department of geology, in a communication to the journal *Science*.

A clue to the reason for the mysterious relationship arose from German war experiments in the making of synthetic mica. Growth of large mica sheets was facilitated in these experiments by a weak magnetic field imposed across the crucible in which the mica materials were being melted. Earlier Japanese work suggested a direct relationship between earthquakes, volcanic eruptions and magnetic anomalies.

Changes in the minerals and their orientation in the rocks under the growing process in the earth's crust, which the geologists know as metamorphism, may be linked with unusual magnetic effects.

Dr. Weaver suggests laboratory experiments on the effect of magnetic and electrostatic fields on crystallizing minerals, together with field studies of magnetic phenomena in areas like the West Indies where the crust is geologically active.

Volcanoes Make Iron

➤ IRON in upper Michigan was deposited in a setting of an isolated ocean basin surrounded by volcanoes, Dr.

H. L. James of the U. S. Geological Survey said recently.

The iron-rich rocks, volcanoes and the great ocean trough of upper Michigan are believed related, he told members of the Geological Society of America.

The lowest rocks found in this trough, he said, are iron-poor and represent material laid down on a shallow ocean shelf. The next group of rocks, resting on this shelf, are iron-rich, while the most recent layer of rocks represent debris from volcanic explosions deposited on top of the iron-rich layer. By comparing the three types of rocks, it is possible to reconstruct the conditions of upper Michigan's scenery over a billion years ago.

Crust Like Marble Cake

➤ THE EARTH'S crust under the continents is more like a marble cake than a layer cake.

This conclusion was reported by Dr. M. A. Tuve of the Carnegie Institution of Washington to the American Philosophical Society after a study of more than 250 shots, each using one ton or more of explosives, which were provided by the Navy and mines and quarries. He and his colleagues challenge the prevalent idea that the deep rocks under the top sediment of continents are divided into fairly even, regular layers. About 2,000 observations were made to examine structures down to 40 miles depth.

When only a few observations of an explosion were used, the records were deceptively like those from earthquakes. When they used many of the explosive shots in their calculations, however, and compared values found at different stations, they discovered that the shock waves did not travel in layers as previously pictured by earthquake investigators. Instead, there was an interference effect, caused by the "marble cake" structure of the interior.

Records at fixed locations from a few shots or a few earthquakes would mislead anybody into thinking the interference pulses came from distinct buried layers, but this picture was disproved by moving the shots and using portable seismic equipment.

Physicists learn about the deep structure of the earth by studying and comparing earthquake records. Dr. Tuve and his colleagues believe that their recent investigations have shown that the layer cake structure is much too simple a picture of the rock pattern deeply buried under continents as a remainder of bygone epochs of mountain building.

Cheaper Vitamin and Hormones

➤ CHEAPER ways of making vitamin D and various hormones are forecast through discovery of the manner in which NBS chemical, once a mere laboratory curiosity, takes part in transforming cheap sterols into valuable medicinal chemicals.

Dr. Geoffrey R. Buckwalter, research manager of F. H. Levey Co., Philadelphia, and Prof. Roderick A. Barnes of Rutgers University, report chemicals that act similarly to the N-bromosuccinimide (NBS) chemical.

New Insecticides Use Three Ways to Kill

Effectiveness

Reprinted from "For Instance," American Cyanamid Co.

➤ SPECIALIZATION may increase local effectiveness, but ideal effectiveness is attained by intense action over the greatest possible area. Science and industry strive for this ideal in the development of new products. The parathion insecticide is a typical example because "it is more effective against a greater variety of insect pests than any previous insecticide."

Parathion's close approach to ideal effectiveness is related to its three-way attack on insects in contrast to the one-way attack of o'd type insecticides. The old type are: ingested with food and kill by poisoning, or are absorbed following contact with the insect's body, or they are inhaled with the air into the respiratory system. Parathion utilizes all three methods of attack thereby gaining a distinct advantage over the old types.

Parathion kills by completely disorganizing the nervous system through chemical action. To understand how this is accomplished we recall that animal bodies are essentially chemical systems. They are more intricate and automatic than any man-made laboratory or chemical plant. When we, or insects, wish to move a muscle our nervous system receives a stimulus activated by the chemical acetylcholine, released at the appropriate nerve. This action is controlled by release of another chemical, cholinesterase. Should anything interfere with the function of cholinesterase, all control of nerves and muscles is lost. Parathion inhibits cholinesterase, which means that if enough is taken into the body it will be fatal to animals and insects. It also means that this potent poison must be used with extreme care by the farmer. However, the necessary precautions have been made available to him and he is warned to follow them carefully. The precautions include proper methods for handling and for personnel protection; they also warn against use in homes, barns and on domestic animals.

The life cycle of insects is short, and their ability to reproduce is tremendous. Since the "survival of the fittest" is still valid, selection of favorable mutants occur and insect resistance to some insecticides has been observed. Insects challenge man's right to existence to a much greater extent than is realized. It is fortunate that insecticide research is helping man to keep abreast of insect aggression by developing new and more powerful poisons. However, in some cases man is barely holding his own, so relentless effort must be continued to eliminate the insidious depletion of our food supplies by these marauders.

Most of the higher forms of shell-building sea animals use for building materials only mineral substances removed from the sea water.

Insecticides Inside Plants Promise Better Pest Control

Man Fights Bugs and Weeds

➤ THE ANSWER to a farmer's most fantastic dream, plants that kill their own insect pests, now appears within the realm of possibility.

This dream lies in new systemic insecticides, phosphorus compounds developed in Germany, which are used not on the outside of the plant but inside it.

Fed to the plant by spraying the leaves, through irrigation water or by direct injection into the trunk, these new compounds become part of the plant system. Sap carries the insecticides even to new growth, and aphids and mites sucking on it are poisoned.

Moreover, it doesn't kill "friendly" insects — the bees that pollinize the plants or the ladybirds and others that prey on pests. The remarkable systemics just kill the insects feeding on the plant.

The phosphorus compound systemics have set off studies involving an almost world-wide team of research scientists, even the Atomic Energy Commission. While the study is only begun, Dr. R. L. Metcalf, chairman of the division of entomology at the University of California's Citrus Experiment Station at Riverside, believes the outlook is more hopeful than for any other chemical pest control in sight.

Some 500 phosphorus compounds are being tested by the Citrus Experiment Station, many of them from the laboratory of Dr. Gerhard Schrader, of the Bayer Co. in West Germany, once a unit of the huge I. G. Farben chemical industries combine.

Ironically, these compounds which may become one of man's great chemical benefactors stem directly from World War II research into the deadly phosphorus compound "nerve" gases. Their effect on enzymes essential to the nervous systems of insects makes them effective pest controls.

The scientists see hope in the systemics for possible control of the aphid-spread quick decline virus in California orange groves. They even dream of developing systemics which might be administered to domestic animals to protect them from lice, mites, ticks or biting flies.

Kills Weed Seeds

➤ A CHEMICAL that kills weed seeds as they start to germinate and thus can be used to keep unwanted growths out of plant fields was shown at the Chemical Industries Exposition.

It is a variation of the 2,4-D compounds that have been widely used as weed killers. Its chemical name is sodium 2,4-dichlorophenoxyethyl sulfate. A product of Carbide and Carbon Chemicals Co., it was developed at Boyce Thompson Institute for Plant Research at Yonkers, N. Y., and tested at Seabrook Farms in New Jersey.

The soil activates the chemical upon contact with it. Thus it is harmless to foliage at the low concentrations that

are applied. It kills or stunts most shallow-planted seeds during germination but usually does not affect deeply planted large seeds or established plants with deep roots. It controls such weeds as chickweed, lamb's quarters, purslane, redroot and carpetweed, and also annual grasses such as crabgrass and foxtail, affecting them for two to four weeks, depending upon the weather.

Wipes Out Living Plants

➤ A NEW CHEMICAL that wipes out all living plants and keeps ground free from vegetation has been developed.

The first use of this CMU chemical will be along railroad tracks, in lumber yards, gasoline storage and other areas that need to be kept free of burnable materials.

If future wars should justify an attack on the enemy's crops, this new chemical might be scattered over fields to make them useless.

Developed by Du Pont's research scientists, H. C. Bucha and Dr. C. W. Todd, the new herbicide is chemically 3-(p-chlorophenyl)-1,1-dimethylurea, hence its short name of CMU. It is safe to use, as it is not corrosive and only very slightly toxic to man and animals. It acts through the roots of the plants. About 20 to 100 pounds is used per acre.

It is particularly effective on grassy weeds, but it does not have a selective action like 2,4-D which attacks the non-grasses and kills many other plants. It is a total killer. Borax has been used for a similar purpose but larger concentrations are needed.

Predict Success

➤ MAN IS making progress in his battle against flies, and the "chances for future control are good," Dr. Ralph E. Heal, technical director of the National Pest Control Association, told that organization's annual meeting.

But we will have to give up our reliance on insecticides only for such control, he warned, and return to sanitation as a major phase of fly control. This is because flies exposed to various insecticides build up a resistance to that chemical, and they pass this resistance on to their offspring. This resistance is not only to DDT but to some of the newer insecticides, such as methoxychlor, chlordane, lindane and dieldrin. The immunity to DDT can persist through many generations, as many as 30 or more.

However, better sanitation and more skilled application of insecticides, plus such measures as screening, would give control over flies, Dr. Heal predicted.

DDT-Resistant Flies

➤ PROGRESS in the battle to find a new weapon against DDT-resistant flies is being made by entomologists at the University of California's Citrus Experiment Station.

They have found ways to reactivate DDT by combining it with other chemicals. These combinations are known as "synergists," and they are expected to prove a potent weapon against flies that can now walk unscathed through formerly lethal doses of DDT.

The fly-killing property of synergists has been boosted from 50 to 200 times the effect of DDT alone on the average, resistant southern California fly, 1951 model, Dr. Ralph B. March of the California station reported.

About 100 different combinations have been tried, of which a dozen have shown promise. Although alone they do not kill flies, all the added materials are closely related chemically to DDT. Much testing, however, remains to be done on the new combinations, Dr. March cautioned.

Flame Throwers Remove Snow

➤ In spite of new methods of clearing snow from walks and streets the snow shovel is not yet obsolete. Neither are the snowplows and scrapers that pile the city snow in the gutters to become a nuisance for many days if cold weather continues or removal steps are not taken. The new methods developed are not all ready for general use.

Science seems to think the best way to remove snow from city streets and sidewalks is by melting it so that it will take itself away as water through the drainage system. One method is to have the fire department flush the streets with city water. If the weather is cold the method has little success. Salt water from the city harbor is more effective in cities close to the briny deep.

Widely used throughout the United States is treatment with common salt or calcium chloride. It is a successful method but has its drawbacks. Salt tracked into a house on wet shoes may injure rugs. The salty water thrown up against the underside of an automobile aids corrosion. And there is some evidence that salt is injurious to the concrete surface of the roadway.

Among new snow-removal methods now proposed and already in use to a certain extent is melting by flame-throwers similar to those developed during the war to drive enemies out of fox-holes. One type has the flame-thrower attached to the front of a truck with a supply of liquid fuel in tanks on the motor vehicle. Whether the method is cheap enough for extensive use is not yet known.

Radiant heat is also used. In this method, pipes embedded in the paving carry steam or hot water from adjacent buildings. Several large stores in New York City are keeping adjacent sidewalks clear by this method. The ramps which buses climb into New York's new giant bus station are radiant heated. In Oregon a steep hill on a highway is piped with hot water from a nearby hot spring.

Among new developments is a chemical to mix with salt before it is spread on a road that prevents much of the corrosion to automobiles that occurs otherwise.

For the door steps and perhaps the front walk, is an electrically heated rubber mat which operates on the household current. It is made of a conductive rubber, a type developed to prevent icing on airplane propellers and the leading edges of aircraft wings. Its surface is grooved so that the melted snow on it runs off to the sides.

Sugar supplies Americans with about one-seventh the total calories in their diets.

The Rare Earth Elements

by Burton L. Hawk

➤ I shall never cease to marvel at the amazing systematic pattern into which all of the elements fall. If one arranges the elements in the order of their increasing atomic numbers, it will be noticed that after each group of eight elements similar chemical and physical properties reappear. These elements with the similar properties may then be grouped to form chemical "families." We proceed quite nicely down the list of elements until we strike element No. 57. Then another amazing point is observed. Following element 57 the next 14 elements, through No. 71, are remarkably similar to *each other*. They do not fall into any of the family groups we have listed. In short, they break up our systematic pattern.

These are the so-called "rare earth" elements. They just do not seem to belong anywhere. What shall we do with them? What is the rhyme or reason for their existence? Usually in Periodic Tables they are listed separately outside the regular table or in a special group at the bottom.

Because the properties of these mysterious fifteen elements are so nearly identical it is extremely difficult to separate them. Even today, a number of them have not yet been prepared in a pure state. Very few uses have been found for the elements and consequently they lay neglected for years. The famous chemist Sir William Crookes once said: "The rare earths perplex us in our researches, baffle us in our speculations, and haunt us in our very dreams. They stretch like an unknown sea before us, mocking, mystifying and murmuring strange revelations and possibilities."

The most plentiful and most popular of the rare earths is cerium. As it is readily obtainable, we shall experiment with it as a representative of the group. The oxalate is the most common of its compounds. You should be able to secure cerium oxalate from any chemical supply house, or maybe even the local druggist will sell you a small quantity. The compound you obtain will be marked "N.F." and will contain varying amounts of the oxalates of lanthanum, praseodymium, neodymium, and minute traces of other rare earth elements. We certainly shall not attempt any purification or any separation of the other elements at this time.

Cerous oxalate is a light pink powder used in medicine as a gastric sedative. It is insoluble in water.

Cerium dioxide, CeO_2, is formed by heating the oxalate. Place one gram of cerous oxalate in a dry evaporating dish. Heat strongly until a heavy brown powder is obtained. Pure cerium dioxide is pale yellow. The brown color here is due to the oxides of lanthanum, praseodymium, etc. Cerium dioxide is used as a contrast medium in roentgen-ray work.

Cerous Chloride, $CeCl_3$, is colorless

The Rare Earth Elements

Name	*Symbol*	*Atomic Number*	*Atomic Weight*	*Melting Point*	*Year Discovered*
Lanthanum	La	57	138.92	860	1839
Cerium	Ce	58	140.13	800	1803
Praseodymium	Pr	59	140.92	950	1885
Neodymium	Nd	60	144.27	850	1885
Promethium	Pm	61			1945*
Samarium	Sm	62	150.43	1350	1879
Europium	Eu	63	152.0	1150	1889
Gadolinium	Gd	64	156.9		1880
Terbium	Tb	65	159.2		1843
Dysprosium	Dy	66	162.46		1886
Holmium	Ho	67	163.5		1878
Erbium	Er	68	167.2	1250	1843
Thulium	Tm	69	169.4		1878
Ytterbium	Yb	70	173.04	1800 (?)	1878
Lutetium	Lu	71	175.0		1906

** Prepared synthetically by atomic bombardment.*

and very soluble in water. Dissolve as much of the cerium dioxide just prepared as possible in 10 cc. of dilute hydrochloric acid, heating if necessary. Filter.

Cerous Hydroxide, $Ce(OH)_3$, is obtained as a white precipitate by adding a solution of sodium hydroxide to the filtered solution of cerous chloride.

Cerous Nitrate, $Ce(NO_3)_3$, is used in medicine in the treatment of chronic diarrhea, dyspepsia and pyrosis. Its solution in the proportion of 1:1000 checks the growth of bacteria. To prepare it, filter off the hydroxide just prepared and dissolve it in dilute nitric acid.

Ceric Nitrate, $Ce(NO_3)_4$, is a yellow compound. Ceric salts are less stable than cerous. Generally they can be obtained by oxidation of the cerous salts. Add a small amount of nitric acid to your solution of cerous nitrate along with lead dioxide (PbO_2). Heat the solution and keep adding lead dioxide until no more dissolves. Boil for five or ten minutes. Then filter to obtain the yellow-colored solution of ceric nitrate.

A delicate test for cerium can be formed by adding hydrogen peroxide to a soluble cerium salt followed by ammonium hydroxide. A light brown precipitate is formed. Try this test on your cerous chloride solution.

Cerium metal is extremely difficult to isolate in the pure state. It is found in *monzanite sand* along with other rare earths. The mixed chlorides of the various rare earths are prepared from this mineral and then by electrolysis in the fused state, an alloy of rare earth metals is obtained. This alloy is known as *misch metal*. It is

pyrophoric, meaning it emits sparks when scratched. Alloyed with iron it is used in cigarette lighter 'flints.'

Dissolve a few flints in dilute hydrochloric acid and filter. You, of course, can easily determine the presence of the iron in this alloy by adding a few drops of the solution to potassium ferrocyanide solution. The familiar light blue precipitate is formed (Turnbull's blue).

Now, how to separate the iron from the cerium? Well, we notice one peculiarity of cerium. Cerium oxalate is soluble in *hot* ammonium oxalate solution, while ferrous oxalate is not. So add a solution of ammonium oxalate to your solution of ferrous-cerous chloride. Now heat the solution almost to boiling and filter quickly while still hot. Now if our theory is correct, the cerium oxalate will pass through while the ferrous oxalate will remain on the filter paper. To prove the theory, test the filtrate for cerium as described above.

Despite much laborious research work, the properties of the rare earths still are not fully known. Because some of them are formed as by-products of atomic research a new interest has been created. Here is a field which invites investigation—for surely some good use can be found for these "haunting, mysterious" elements.

How to Fight A-Bomb Fires

➤ A NEW MANUAL for the training of auxiliary and regular firemen in the fighting of fires set by A-bombs and incendiaries, published by the Federal Civil Defense Administration, takes into account the danger from the powerful "fire storms" which were experienced by Hiroshima and Hamburg during World War II.

Already fire wardens from cities throughout the nation are being trained in this kind of fire fighting at a special school at Oklahoma Agricultural and Mechanical College. Another such school will open near Philadelphia.

Meantime, Federal civil defense officials are preparing suggestions to cities on how to make themselves less vulnerable to fire caused by A-bombs. Under the law these, of course, will be only suggestions.

They will include such matters as the preparing of fire brakes and erection of fire walls, the use of fire-resistant paint, the proper spacing of new construction. Information on the kinds of construction which will best resist fire will be included.

This is not one minute too soon, according to Horatio Bond, chief engineer of the National Fire Protection Association. In 1946, we knew most of what we need to know to make our cities more fire resistant. Military men, he said, could have begun advising municipalities on new construction at that time.

It takes congestion, he points out, to produce the fire storms which swept through Hiroshima and Hamburg. Sensible planning of new construction and tearing down of older buildings might allay this danger.

Steel and Other Metals Helped by New Processes

Better Use of Common Metals

➤ ELEVEN huge new open hearth steel-making furnaces in Pittsburgh, capable of an output of 2,000,000 tons annually of steel ingot, will go far in relieving the present steel-shortage situation in America, due to emergency world conditions. The first heat of steel was tapped recently in public ceremonies dedicating the new plant.

This new plant was built and will be operated by Jones and Laughlin Steel Corporation, the nation's fourth largest steel producer, and will increase the company's annual production of steel ingots from close to 5,000,000 tons a year to 7,000,000 tons annually. Construction was started in May 1950 and was pushed to completion in record time because of the steel emergency. The tapping marks the first major increase in the country's ingot production since the beginning of the Korean emergency.

Open hearth furnaces are called the greatest steel producers of all time. During 1950, over 85% of the steel ingot production in the United States was from open hearths. The first basic open hearth furnace in this country was built in 1880. Since that time great strides have been made in developing more efficient and larger open hearth furnaces.

These new furnaces now in operation will go far in helping the American steel industry meet its own objective of producing this year 118,000,000 tons of steel. On Jan. 1, 1951, total steel-making capacity stood at a little over 104,000,000 tons. Steel companies are currently engaged in the greatest two-year period of expansion in history.

Pressure Blast

➤ AMERICAN iron blast furnaces could produce an additional 1,000,000 tons of pig iron each year if converted to a new method of operation involving air pressure, it is stated by Dr. B. S. Old of Arthur D. Little, Inc., development laboratory, of Cambridge, Mass. This engineering firm originated the process.

In operating a furnace under this pressure method, the exit-gas system is throttled so that pressures are built up at the top of the furnace. They are built up to about 12 pounds above the normal atmospheric pressure now used. With the system throttled down, the air blown in the bottom of the furnace moves more slowly, so that it is possible to blow a greater weight of compressed air through without blowing valuable ore out of the furnace. The availability of more air permits the burning of more coke per day and thus the smelting of more iron per day.

The first pressure furnace started regular operation in 1946, Dr. Old reports. Eight are now in operation in the United States and one in England. All six of the large blast furnaces under construction in America will operate under pressure, and five old furnaces are now being converted to pressure. Operating cost per ton is

reduced by the pressure system, it is claimed, because of the increased output and more efficient use of coke.

Life of Metals Determined

➤ THE PROBABLE life of steel alloys, other metals and plastics in moving parts of machines can now be determined in greatly decreased time by a new process based on precise measurements of samples under controlled heat. The process was developed at Rensselaer Polytechnic Institute, Troy, N. Y., by Dr. Joseph L. Rosenholtz and Prof. Dudley T. Smith.

Apparatus for carrying out the determinations has also been developed by the two scientists. It makes possible the completion in 10 hours or less of a testing job which has been requiring three months or longer on costly machines under expert supervision.

The discovery is important to many industries because of the constant search for materials to meet new and demanding standards. Thousands of tests are made annually to determine if a new material will permit faster and cheaper production satisfactorily. This new method makes possible the rapid and inexpensive testing of materials for tank engines and jet motors, as well as for propellers, turbine blades, revolving shafts and many other machine parts.

The Rensselaer scientists discovered that identical samples of rods of steel or other material, when heated under exact controls to the same temperature, possess rates of expansion in length which vary with the amount of stress to which each test piece has been previously subjected. They have devised an apparatus which measures such expansion to an extremely sensitive degree.

The process uses eight small test pieces two inches long and two-tenths of an inch in diameter. These bars are subjected to stresses in a definite range. They are then put through an equal number of cycles of vibration so that they will be on an equal level of fatigue.

The samples are then put in the special apparatus and subjected to controlled temperatures from room temperature up to that of boiling water. The apparatus automatically magnifies and records the linear expansion of each specimen 3,500 times. The endurance limit of each specimen is determined by plotting the linear expansion against the stresses previously applied.

Lead Supply Conserved

➤ AMERICA'S precious supply of lead can be made go farther, particularly in sulfuric acid manufacture, through a new metal bonding process exhibited by Knapp Mills for the first time at the Chemical Industries Exposition.

A thin layer of lead is bonded upon steel to make it resistant to acid corrosion. In another metal combination, copper is clad with lead and the new material has lead's acid resistance and copper's high electric conductivity and heat transfer.

In making sulfuric acid, which is in critical need in industry and defense production, the new lead-clad metals are expected to release many thousands of tons of pure lead for other or more extensive uses.

The lead-clad copper will allow the use of freon instead of water in coils in which acids are cooled. It will also

allow increasing ten-fold the electrical charge in electroplating.

The stronger base metals used will allow the application of acid-proof metal to many uses that pure lead itself cannot fill.

The lead-clad steel is produced by an automatic process patented originally by the American Viscose Corporation for use in rayon manufacture, while the lead-clad copper is made by a process developed by Knapp Mills that draws lead and copper simultaneously and chemically bonds them together.

Aluminum Bases Save Copper

➤ ALUMINUM is being used in the bases of incandescent electric light bulbs instead of the long-used brass, thus saving critical copper for defense purposes, according to General Electric's Lamp Department. In the future either metal can be used, depending upon which may be in least critical supply.

The lamps with aluminum bases are identical in life, efficiency and cost to the familiar brass-based bulbs. In addition they have the advantage of being resistant to tarnishing, and of maintaining a general better appearance. Aluminum also has excellent electrical properties, being two and a half times as good a conductor of electricity as brass.

Pure aluminum is not used in the new bulb bases. Instead it is a special alloy that will withstand the high temperatures used by machines on which lamps are assembled. To manufacture them a special solder and flux had to be developed which were suitable for use in a high-speed automatic operation.

Before the aluminum alloy was adopted it was necessary to make exhaustive tests concerning such matters as electrolytic corrosion in brass and copper sockets, corrosion characteristics in various atmospheres, and contact resistance between the base and socket.

Atoms Tell Where to Put Fertilizer

➤ EXPLODING atoms of phosphorus are helping scientists to know just where to place fertilizer so that crops can get the most out of it.

Scientists from the U. S. Department of Agriculture and State Experiment Stations gathered at Beltsville, Md. recently to report on the use of radiophosphorus and other similar atomic-reactor manufactured isotopes (atomic varieties) in fertilizer studies.

Instead of spreading the fertilizers broadcast over the field and gardens, agriculturists learned some years ago to place the added plant food closer to the seeds and roots in rows and small patches.

Radiophosphorus, which by its radioactivity can be traced in the plants, is now telling what methods of application are most efficient, Dr. R. Q. Parks, head of the U. S. Department of Agriculture soil management and irrigation division, explained in opening the conference. It is possible to trace how much of the plant's phosphorus comes from the soil and how much from the fertilizer.

National Research Council Committee Reports on Food Preservative Industries

Chemical Additives in Foods

There is no evidence that consumption of foods resulting from the use of new chemicals in crop production or in the processing of foods has created mysterious diseases and epidemics or endangered the health of the people, the National Research Council's Food Protection Committee of the Food and Nutrition Board declares.

A carefully worded statement released by the Food Protection Committee notes that these chemicals are essential in the production and processing of many crops. Panels of outstanding scientists, nutritionists, government specialists, and industrial research directors based their report on a year's study of scientific data on the benefits and possible hazard of chemicals used in connection with foods.

"Contrary to some ideas that have been circulated, reliable food processors have not reduced the nutritional quality of our foods or created inferior products through the use of chemical additives," the statement reads. "Actually, the quality and sanitary characteristics of our foods have been improving."

Recognizing the challenge to increase and improve food production, the Committee adds: "It is to the credit of industrial concerns and law-enforcing agencies that they have been able to make so much progress without jeopardizing the health of the public."

The American people now enjoy the most abundant and varied diet of any nation in history. This is possible because of improvements in food production and technology. Chemicals have played an important role in many of these improvements.

When this country was settled, nine farm workers produced enough food for themselves and one city dweller. By 1940, one farm worker could produce enough for himself and nine others. Today the ratio has further increased; 14 urban dwellers now depend on each farm laborer. This efficiency has been achieved even though there have been increasing difficulties from disease and insect pests and the depletion of three-quarter million acres of fertile land by soil erosion.

The food processors have matched the progress on the farm by creating new industries for food preservation. Today there is available in every community a steady supply of fresh fruits and vegetables and processed products that retain practically all of the nutritive quality and appetizing flavor of the fresh product. Dairy products and baked goods are distributed regularly to rural and urban customers.

These achievements were made possible by the discovery of many new scientific principles in biology, chemistry, and engineering, and by the invention of new machinery. The public has recognized the obvious advantages resulting from the use of labor-saving machinery such as the tractor, corn

picker, pea sheller, and frozen food locker. Many people, however, have not been aware of the importance of chemicals in this program or the nature of the problems presented by their use.

This statement has been prepared by the Food Protection Committee to give some of the basic facts regarding the use of chemicals in foods, and the research and legal measures now being employed by industry and government to ensure protection of the public.

Constituents of Foods

The constituents of foods are chemicals and may be classified as carbohydrates, fats, proteins, minerals, water, and accessory factors such as vitamins. The carbohydrates include various sugars, starches, dextrins, celluloses, and gums. Most of these are oxidized in the body to release energy for muscular activity and other chemical reactions. The fats and oils supply energy and essential fatty acids and facilitate absorption of fat soluble vitamins. The amino acids from proteins are used as building materials for muscles and other tissues or as a source of energy. The minerals such as salts of calcium and phosphorus are used in building skeletal structures and teeth. There are vitamins of various types present which regulate cell functions and are essential to normal metabolism even though they are present in minute quantities. Such factors as the variety of crop, soil fertility or nutrition, intensity of sunlight during growth, disease, and methods of harvest and storage affect the chemical composition and nutritional quality of each product.

Each foodstuff consists of chemicals that are more or less characteristic of it. Milk, for example, contains water and solid matter, the latter consisting of a variable amount of butterfat, milk sugar (lactose), proteins (such as casein and lactalbumin), minerals (notably calcium and phosphorus), and other chemical constituents. These constituents of milk vary somewhat according to the breed, the individual cow, the period of lactation, and the nature of the feed of the cow. Milk from Holstein cows is somewhat lower in fat and carotenoid pigments than that of either Jersey or Guernsey. Milks from different sources are quite generally blended or standardized to a definite level of butterfat.

Milk received at evaporating plants at different seasons and from different herds varies in stability to heat which affects the consistency of the finished product. Heat stability is dependent upon the balance in the milk of the natural mineral salts, particularly the proportions of calcium, phosphate, and citrate. It is often necessary, therefore, to add one or the other of these chemicals in order to produce sufficient heat stability for a marketable product. This is a case of adding a constituent normal to milk to help standardize the product.

Standardization

Standardization procedures comparable to those described for milk are carried out on various other foods, as in the blending of wheat varieties to secure a flour of uniform baking quality.

In addition to the natural variation in chemical composition of foodstuffs, chemicals may be incorporated during

the growing or during the storage and processing of the food. These chemicals may be described, for convenience, as "additives." When they are introduced to preserve or improve the quality of the product, they are known as intentional additives because they are purposely added to serve a specific need. Such materials as artificial coloring, synthetic flavors, sweeteners, vitamins for enriching bread, mold inhibitors, bactericides, antioxidants, emulsifiers, and minerals are intentional additives. They are added to the food product in carefully controlled amounts during processing.

In addition to the intentional additives, other chemical additives may be present in foods when they are marketed. These are known as incidental additives. For example, pesticides required for the production of crops may remain in small quantities on foods. They can be avoided on or in foods to a large extent by proper use of materials during the growing and processing of the crop.

Every chemical used in food production and processing should improve nutritional value, enhance quality or consumer acceptability, preserve food, or make it more readily available to the public. Since there are many methods of improving food products and the efficiency of their production, only a few examples can be cited.

Enrichment of Bread

The enrichment of flour and bread with essential nutrients has improved the diet of the American people. The controlled addition of iodides to table salt to prevent goiter, and fluorides to drinking water to help prevent tooth decay, have long been advocated by responsible groups.

Uniform products are expected by the public and chemicals are used to help attain this uniformity. Examples of such use of chemicals are the addition of naturally occurring materials such as phosphates and citrates to evaporated milk, minute amounts of dyes to color margarine or to color butter to compensate for seasonal variations, and flavoring agents, both natural and synthetic, to control flavor intensity in many processed foods. Consumer dissatisfaction would result if, for example, brand-name products differed in flavor or color with every package.

Chemical Additives

Chemical additives are needed to preserve some foods and their use has long been an accepted practice. Spicing and smoking of food products are typical examples of food preservation. Vinegar or sodium propionate is frequently used to prevent the molding of bread. Antioxidants may be added to fats and fatty foods to prevent rancidity. Under no circumstances can preservatives be justified as a substitute for good sanitary practice. It is obvious, however, that the cost of food would be increased and its distribution would be handicapped by omitting them.

Maintenance and improvement of the present nutritional status of the American public is contingent upon the continued production of an adequate food supply. Plant and animal pests rank among the foremost causes of food destruction, food deterioration, and food contamination. Hence, the necessity of protecting growing crops and produce from serious attack by insects, plant diseases, and other pests is recognized both from the

standpoint of quantity and the quality of the food produced. In recent years science has placed in the hands of the farmer, the food handler, and the food processor many valuable chemicals to aid in the unending war against pests of all types.

The possibility that small quantities of pesticide residues may remain after harvest in the edible portion of treated crops has caused concern because some pesticides are known to be toxic to warm-blooded animals, and also because some crops need to be sprayed 5 to 12 times during the growing season to prevent damage by insects and crop diseases. Frequently, stored products such as the cereal grains must be further treated with fumigants to prevent infestation by insects and the growth of micro-organisms.

Pesticide Application

The application of pesticides is an expensive, disagreeable task that must be done at the time the farmer's other duties are heaviest. However, many crops would be destroyed if left unprotected. Crop failures occasionally might be escaped, but this risk cannot be taken in view of present intensive crop culture. Heavy investments in land, fertilizer, expensive farm machinery and labor must be protected from crop losses due to devastation by disease, insects, and weeds. Use of pesticidal chemicals is an essential form of crop insurance. Although the pesticides cost about $200 million in 1949, and the quantity used in 1951 was materially larger, this is an unavoidable expense in modern agriculture.

Many things have contributed to the prevalence and destructiveness of insects, fungi, bacteria, nematodes, and viruses during the past 50 years. Farmers are now forced to use the same fields over and over since there is no more virgin prairie and forest soil to bring under cultivation. They can no longer move westward when fields become non-productive, as their grandfathers did in the last century. This gives the pests an ideal opportunity to find food plants in the immediate locality where they are established. After several generations they become so well adapted to the crop plants that they become extremely destructive.

Life Cycle of Pests

Many farmers have found it difficult to use the long rotations of four, five or more years necessary to break up the life cycle of these pests. Another contributing factor is the present intensive cropping system in which crops have been bred to such a state of uniformity that every plant in a field is almost equally susceptible or resistant to disease and insects. A few decades ago growers used open-pollinated, heterogenous varieties which varied in nearly every characteristic. Some plants might be attacked but others were sufficiently resistant so that affected crops were not, as a general rule, completely destroyed. Today, if a disease becomes established in a field it sweeps through all the plants like wildfire. By increasing the yield, uniformity, disease resistance, and many other desirable characteristics of crops, substantial gains have been achieved but at the price of greater hazard from pests.

In addition to our native pests, there have been introduced inadvertently several foreign ones. Some of these, such as the European corn borer and

Mexican bean beetle, have become major factors in crop production. Quarantine barriers have not entirely excluded crop pests; many enter sooner or later on introduced plants, by wind-borne spores, or as flying adults.

Some enthusiasts have argued that plant diseases and insects could be controlled without using chemicals by the improvement of soils with organic matter. Agricultural scientists appreciate the value of organic matter in the soil but recognize that its presence is no guarantee against infestation. Diseases and insects were destroying plants long before man began cultivating crops and destroying soil organic matter.

Every effort is being made to control insects and diseases by good cultural practices. Plant pathologists and entomologists generally recommend that old crop refuse be plowed under or destroyed if pests live over the winter in it. Rotations with other crops are urged wherever possible, not only to starve out pests but to maintain balanced fertility and organic matter in the soil.

Escape Tactics

Intense effort is spent in locating geographical areas where pests are not established or fields where disease and insect pests are not likely to strike. By choice of suitable planting dates, many pests, such as the Hessian fly on wheat, in breeding crops for resistance to diseases and insects. Some astounding achievements have been accomplished by this research on pest-escaping tactics.

The development of resistant varieties is important but has practical limitations. The resistant varieties may be perfect against one strain of a fungus, for example, but some parasites have as many as 200 strains. Experience has shown that a disease-resistant variety of oats or wheat will last only about 10 or 15 years before a new strain of the parasite develops and attacks the variety.

What would happen if chemicals were not used to control pests on crops? No one has risked such an experiment on a large scale. It is possible, however, to ascertain what is happening in spite of the best control measures and give some reliable opinions of what might be expected.

The Corn Borer

The corn borer was introduced into Massachusetts from Europe about 1917 and by 1927 had extended to Ohio. Within the past 15 years it spread into the corn belt with losses of 30 to 50 per cent on many Illinois and Iowa farms. Corn production was seriously threatened before DDT was introduced because losses increased from $5 million, in terms of 1941 prices, to $103 million in 1948 and $350 million in 1949 on the same basis. If chemical controls had not been developed in 1950, food for the livestock industry would have been reduced.

In Pennsylvania, yields of unsprayed apple trees declined over a six-year period so that they averaged only two bushels per tree as compared to 11 bushels from sprayed trees next to them. A survey of sprayed and unsprayed orchards in that state showed that 82 per cent of the unsprayed fruit was destroyed by scab. Qualified authorities readily admit that this disease would eliminate apples as a crop in Pennsylvania if trees were not sprayed regularly. The average loss

from this one disease alone in the United States is about 5.6 per cent, despite the control measures now being employed. Over the period 1920 to 1939, the estimated monetary loss averaged about $10.5 million per year. The codling moth caused almost as much damage during the period 1944 to 1948. Prior to the discovery of DDT the loss averaged about $50 million a year (15 per cent of the crop).

Tomato Blight

An excellent example of the destruction that can result from the unchecked attack by a pest occurred on tomatoes in 1946. Late blight, a fungus disease, became established in Florida early in the season and progressed northward. Less than 10 per cent of the tomato crop was being sprayed at that time so that there was a good opportunity to study an uninhibited epidemic under modern conditions. The losses, then estimated at $40 million, exceeded 50 per cent in ten of the states along the Atlantic seaboard. Canning factories closed down and the price of market tomatoes increased ten- to twentyfold. Farmers were so discouraged that they discontinued tomato culture. In Pennsylvania, for example, the tomato plantings within two years declined from 34.2 to 19.4 thousand acres. After spray measures were perfected with resultant improvement in yield, the acreage increased. It is doubtful whether tomato culture would have been fully restored in decades without this protection afforded by fungicides.

Some of the other benefits to consumers from use of pesticides are even more impressive. Dairy cattle produced 15 to 20 per cent more milk where spray programs to control flies were introduced after the new organic insecticides were discovered. Treated beef cattle in Kansas averaged 50 pounds more gain per animal than did unprotected cattle when all the animals had the same food supply. These benefits were conservatively estimated at $100 million annually.

The control of grasshoppers in Montana and Wyoming in one year saved enough pasture grass to produce about 11 million pounds of beef. In 1938 almost 9 million acres of pasture and crop lands with crops valued at $68 million were treated. In 1949, treatments saved about $72 million even though another $27 million damage was recorded. Each dollar invested in control yielded a $55 gain in produce during 1949.

These random examples give some indication of how severely a single insect or disease may affect agricultural production. It must be remembered that there are thousands of these pests each attacking crops and livestock in varying degrees. The battle lines between them and man are well drawn. Pests must be controlled or the food supply of the nation will decrease markedly in quantity and quality. These inescapable facts make it plain that chemicals are destined to continue as much a part of farming as the tractor.

Accident Hazard

A clear distinction should be made between hazards which may exist, or result from accident, during manufacture or during the use or application of large quantities of pesticides to protect crops or animals from the ravages of pests, and the hazards which may result if more than minimal quantities of these chemicals re-

main in foods. Food hazards should not be confused with hazards due to accident during manufacture, use, or application.

Also, a careful distinction must be made between hazard and toxicity. Toxicity is the capacity of a substance to produce injury; hazard is the probability that injury will result from the use of the substance in the quantity and in the manner proposed. An estimate of the hazard in relation to any substance must be based upon knowledge of the toxicity and of the details of its use.

There need be no hazards involved in the use of chemical additives in foods provided adequate scientific research programs are carried out prior to the use of an additive. The fact that a chemical is toxic does not mean *per se* that its proper use as an additive will entail a hazard to man.

Toxicity

Practical and effective, though not perfect, scientific techniques have been worked out to determine the toxicity of chemicals to laboratory animals. Taking into consideration the toxicity of the chemical, the amount proposed for addition to food and the variety and types of food to which it is proposed to be added, it is possible to reach an expert judgment of the hazard involved. With this information available, no reputable manufacturer would add any chemical to food when a hazard to the public health is involved. Legal measures are designed to protect the public from any use of chemical additives without these adequate safeguards. A Select Committee of the House of Representatives is at present investigating the adequacy of existing legislation to accomplish this purpose.

Questions of hazards posed by chemical additives in foods require objective unbiased scientific study, with due consideration of many types of possible advantages and disadvantages which may accompany the use of the proposed additive. It is fundamental, however, that decisions regarding foods should aid in making possible an adequate supply of wholesome foods with good consumer acceptability. A wholesome food product must, among other qualities, supply at least the nutritional values which are traditionally associated with the food and it must be safe for continuous use in the diet under a variety of patterns of consumption which are to be expected to occur during the course of its use. Decisions emerging from such a variety of considerations must involve judgments made through understanding and interpretation of critically designed scientific studies. The considerations are so varied as to demand group study and mature, conservative judgment.

Experimental studies of the physiological, pharmacological, and biochemical behavior of a proposed additive, made in various species of laboratory animals and in limited numbers of humans, can reduce to a very low degree the uncertainty of its safety. The extent of such studies of a particular additive in food varies with several factors which determine the amount and form likely to be consumed by the human. A group of such considerations have been proposed recently by the Food Protective Committee.

An intentional chemical additive

should not be used in a food until its safety for a given food use has been established beyond reasonable doubt, as judged by competent experts. Similarly, the safety of incidental additives must be established in terms of their occurrence in food products as marketed. While the ultimate test of complete safety is the alert observation and intelligent scrutiny of the effects of the use of a substance in foods, a new additive should not be used until the best judgment based upon studies on animals, and where possible on man, indicates that deleterious effects will not result.

During the past several years, there has been considerable discussion of the possibility that hazards might accompany the use of chemical additives in the production and processing of foods. Although there has been no justification for any of the exaggerated viewpoints that have been widely circulated, it is true that so many new chemicals have been introduced in the past ten years, and still others are in immediate prospect, that it is well to examine the existing situation.

Nutrition Maintained

Contrary to some ideas that have been circulated, reliable food processors have not reduced the nutritional quality of our foods or created inferior products through the use of chemical additives. Actually, the quality and sanitary characteristics of our foods have been improving. Likewise, there is no evidence that consumption of foods resulting from the use of the new materials in crop production or in the production and processing of foods have created mysterious disease epidemics or endangered the health of people. It is to the credit of industrial concerns and law-enforcing agencies that they have been able to make so much progress without jeopardizing the health of the public.

The first evaluation of toxicity of chemicals is usually made by the companies which create them. This is necessary to protect the employees who must handle the chemicals in the factory and research laboratory, and later, to protect the food and to maintain the good will and confidence of consumers. The reliable industrial concern starts toxicity measurements as soon as a new material shows promise of beneficial use. The first experiments are usually made in their own laboratories or under contract with a private toxicological laboratory staffed by competent toxicologists. In addition to these direct services, many concerns have also established fellowships and grants-in-aid with medical colleges, universities, and hospitals where they can secure disinterested advice and find competent pharmacologists and toxicologists to direct the research.

Most pesticide manufacturers usually complete acute toxicity measurements on at least one animal species by the time they have completed laboratory studies on the usefulness of chemicals under consideration. More extensive experiments, including the determination of chronic toxicity, may be made while the material is being tried in experimental field plots. Pesticidal chemicals rarely prove their value in field use in less than five years of experimentation. Government agencies are co-operating with industry in developing a program whereby the necessary field experiments can be conducted on a limited commercial

scale while toxicological research is still in progress.

Many food processors also have established their own laboratories and have exercised precautions in using new materials. Some of the progress in detecting residues of pesticides and in developing methods for removing traces of chemicals by washing has come from these laboratories. They, too, have sponsored extensive research in colleges and universities, particularly in the field of nutrition.

Although the reliable chemical manufacturers and food processors have established these procedures, there is room for honest differences of opinion in interpreting the hazards involved. Wide differences of opinion can usually be resolved by further study and consultation with the appropriate government agencies.

Federal Agencies

Four federal agencies are responsible for the protection of the public. They function by the administration of different laws and by conducting their own research.

The United States Public Health Service is responsible for public health in its broadest aspects. Investigations are made into the use of chemicals to control diseases and insects affecting man, the effect of chemicals on men associated with the manufacture of chemicals, the effect on spray operators, and the effect of ingested chemicals on man. In addition to using small animals for research, the Service also performs epidemiological field studies and carries out clinical investigations on human subjects whenever necessary. The Public Health Service also acts in an advisory capacity to state and local health departments in devising and enforcing ordinances regulating the handling of food and milk.

The Meat Inspection Service of the United States Department of Agriculture controls the use of certain chemical additives in meat and meat food products under authority of the Meat Inspection Act of 1907. The latter Act provides for special inspectors in any establishment processing meat foods for interstate or foreign commerce. Under this Act, no chemical additives may be used in meat or meat products without approval of the Service.

The Insecticide Division of the United States Department of Agriculture is responsible for the registration of all pesticides under the Insecticide, Fungicide, and Rodenticide Act of 1947. Before any pesticide can be sold interstate, data must be submitted on its ability to control pests, its safety for use by spray operators and on crops, its effects on quality and safety of food, and the potential damage to other forms of life and to soil. The Division does not conduct research of this type, but depends on scientists in the Agricultural Research Administration for advice on usefulness, and on the toxicologists in the Public Health Service and in the Food and Drug Administration for opinions on safety for the proposed use.

The Administrator of the Federal Security Agency is charged with the responsibility of enforcing the Food, Drug, and Cosmetic Act of 1938. He has the power to prevent shipment in interstate commerce of any food adulterated by a poisonous or deleterious ingredient. The Administrator is also responsible for the establishment of standards of identity for food prod-

ucts and for the promulgation of tolerances for chemical additives where these are required in processing. The Food and Drug Administration maintains elaborate toxicology laboratories.

The Food, Drug, and Cosmetic Act directed the Federal Security Administration to establish a safe residue tolerance level for each chemical shown to be a poisonous material but necessary to the production of food. Exhaustive hearings on pesticides were held in 1950 and formal tolerances are expected in the near future. Informal tolerances for lead and arsenic, fluorine, and DDT have been in use for some time. Although many samples of fruits and vegetables have been examined, there have been no seizures by the Food and Drug Administration for exceeding the tolerance on DDT and only three seizures in the past three years for the presence of lead arsenate in excess of the informal limit. Prior to 1947 there were a larger number of seizures for exceeding lead and arsenic informal residue limits because such heavy treatments were required before DDT was introduced to control the codling moth.

New intentional chemical additives may be introduced into foods by either of two procedures. Some foods have established standards of identity promulgated by the Administrator of the Federal Security Agency only after review of all existing data. Anyone wishing to substitute a material for an ingredient named in the standard, or to add a new substance, must petition for a hearing. Many foods do not have established standards of identity so that the food processor must carry the full responsibility for adding any new chemical and must observe the provisions of the 1938 Act that prohibit the addition of poisonous or deleterious ingredients. Reliable processors consult with the Food and Drug Administration and conduct such experiments as may be suggested and additional research which they regard as essential.

Legislation

The adequacy of existing legislation to safeguard the public health in relation to the use of chemicals in foods has recently been under consideration by a House of Representatives Select Committee. The U. S. Commissioner of Foods and Drugs has testified before this Committee that existing legislation is not adequate and additional legislation has been proposed. The opposite viewpoint has also been presented to the Committee.

In addition to the federal laws, 40 states have laws regulating the use and sale of chemicals. These laws are administered either through the departments of public health or agriculture in the various states. Some of these laws are modeled on a uniform pattern, while others vary in important respects. A concerted effort has been made to encourage the standardization of these laws so that the movement of chemicals in interstate commerce would be facilitated.

Food Protection Committee

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Chemical Linked to Tooth Troubles

➤ CHOLESTEROL, a fatty chemical involved in arthritis and artery hardening, now is linked with tooth troubles.

Tests of saliva from people with various disorders of the teeth as well as of the body show this. The tests were reported by Dr. Frances Krasnow of the Guggenheim Dental Clinic, New York, to the American Association for the Advancement of Science.

Persons who are "medically as well as dentally normal" have an average saliva cholesterol reading of seven. Those without tooth disorders but suffering from some disease such as artery hardening or arthritis have a saliva cholesterol reading of nine. Those with dental disorder only rate 11 and those with both tooth and body diseases rate 13. The figures are for milligrams of cholesterol per 100 milliliters of saliva.

When the teeth and the rest of the body are restored to their best state of functioning, the saliva cholesterol reverts to normal, Dr. Krasnow reported.

The new findings on cholesterol in saliva may lead to better understanding of the part this chemical plays in health and disease. In addition, saliva tests for cholesterol may give doctors and dentists a new diagnostic tool which could be easier to use than tests of blood for cholesterol.

Air Pollution Studies Tackled Internationally

Seek Cleaner Air

➤ For the first time, so far as is known, the technical and scientific resources of two nations are being combined to determine the effects of air pollution on the health of populations, J. R. Menzies, chief of the public health engineering division of the Canadian Department of National Health and Welfare, declared at the meeting of the American Public Health Association in San Francisco.

Pollution of the air in the Detroit, Mich.-Windsor, Ont. area is the project now getting this international scientific and technical study. Smoke, soot and fly ash pollute the air of the region from the 30,000 or so passages of vessels each year on the Detroit river. In addition to the river traffic fuel consumption, about 16 million tons of coal are burned annually in the highly industralized Detroit-Windsor area, besides other fuels such as gas and oil.

The International Joint Commission on Air Pollution has since 1949 had studies under way to determine the extent of air pollution in various parts of the Detroit-Windsor area.

When enough information is available from these studies, the Commission will gather information on the health, particularly on diseases of nose, throat and lungs, of six groups of citizens. Each group will be chosen to represent a particular social and economic status in areas of varying degrees of intensity of air pollution. The plan now is to include about 5,000 family units, 500 of them in Windsor and the rest in Detroit. Assuming four persons to the average family, this will give information on about 20,000 persons.

Meteorological conditions in the area will receive special attention throughout the investigation.

Watch Wind Around Factory

➤ Weather is an important factor to be given full consideration in selecting a site for a manufacturing plant that may add pollutants to the atmosphere, the American Society of Mechanical Engineers was told recently by Dr. Frederick G. Sawyer of Stanford Research Institute.

Location of a plant where weather conditions are unfavorable to pollution concentration may save the owners the cost of damage suits later. The time has come, he said, when, in addition to the usual considerations such as proximity to raw materials, water, transportation and labor, the weather must also be considered as an important factor.

The most important feature of the weather to be taken into consideration is the wind pattern. The wind should be examined for direction, velocity, seasonal variation, diurnal changes, and seasonal change in daily patterns. Storm pattern and frequency should be studied. A location which is subject to frequent storms is inimical to air pollution nuisance or damage.

Los Angeles, noted for its "smog," was cited as an example of an area where air pollution is due in large part to weather conditions.

Los Angeles is not a smoky city by eastern standards, Dr. Sawyer said. Almost no coal is burned, so that soot and flyash are not major problems. As in other cities, there are thousands of different emissions of gases, solid particles and liquid droplets. What makes Los Angeles different is the meteorology and topography which combine to accentuate the effects of pollutants present.

The pollutants arise in a basin confined by mountains on three sides. Seasonal weak winds fail to move the polluted air out of the basin. A blanket of warm air known as the inversion layer, acts as a lid over the basin for a large part of the year. When this layer descends to 500 to 1,500 feet elevation, the pollutants are crowed close to the earth and smog results.

Freeze Dry Wastes

➤ FREEZE drying methods which now give us vitamin-C-rich fruit juices for breakfast and blood plasma stockpiles for treatment of shock in injuries, may provide the "real solution" to the pollution of lakes and streams with factory wastes, now a serious problem.

Experiments are now under way to produce equipment which will do this job effectively and economically, George D. Armerding, of Mojonnier Bros. Co., Oakland, Calif., reported at a recent meeting of the American Public Health Association.

Low temperature evaporation equipment is also used in production of insulin for diabetics and of antibiotics, such as penicillin, for fighting germ diseases. Reduction in the cost of these medicines and production in sufficient volume to meet medical demands has been made possible through use of low temperature equipment.

Single-Treatment Fungicide Developed

➤ A SINGLE treatment for tomato plants with a newly developed fungicide will prove effective against all major fungus enemies, to both fruit and foliage, it is revealed by the Du Pont Company. The same fungicide is recommended for potatoes and may later, after extensive tests have been made, be recommended for many other crops.

Manzate fungicide is the name adopted for the new spraying material. Chemically it is based on derivatives of dithiocarbamic acid and its technical name is manganese ethylene bisdithiocarbamate. It has already undergone extensive field tests carried out in 32 states, Canada and Mexico, to evaluate the compound for disease control for many vegetables and also for apples, tobacco, melons and nuts.

A great advantage of the new fungicide in addition to its effectiveness is that it alone gives protection against all fungous diseases on tomatoes. Previously two or more chemicals have been required in alternate applications to control the various diseases. It is particularly recommended to control anthracnose, gray leaf spot and Septoria leaf spot on tomatoes, and early and late blights on both tomatoes and potatoes.

Prevention of Deterioration Center Studies Ways to Avoid Material Loss

To Stay Decay

Reprinted from the Industrial Bulletin *of Arthur D. Little, Inc.*

➤ Protection of the equipment and supplies of the Armed Services is the chief function of the Prevention of Deterioration Center of the National Research Council in Washington, but much of the wealth of information now available can be used by industry as well. The Center acts as a clearing house and consultative agency on technical problems of deterioration, and through its extensive abstracting and publication service offers government agencies, industry, and libraries information on the results of research in a wide number of fields carried on in laboratories throughout the world.

The over-all cost of deterioration in the United States is estimated at about $12 billion annually, exclusive of losses of foodstuffs; moth damage to fabrics costs $100 million and corrosion of metals does between $5 and $6 billion worth of damage. While such losses are of great economic importance to industry, deterioration of military supplies and equipment can be a matter of life or death. The Center was set up as the Tropical Deterioration Information Center under the National Defense Research Committee during World War II, when equipment in wide extremes of environment deteriorated much faster than had been expected. Equipment expected to last for months or years in a temperate climate became inoperable in weeks in the tropics. Emergency measures provided better protection without interfering with wartime production and transportation, but the need for longer-term planning was evident. The present Center, under contract with the Office of Naval Research, and with the financial support of the Army, Navy, and Air Forces, integrates individual research projects and coordinates the attack on broad problems. It also operates a scientific screening program for evaluating such compounds as fungicides and bactericides.

Over 15,000 reports on research and development concerning deterioration both of assembled equipment and of individual materials, such as wood, leather, metals, and fabrics, have been indexed. The Center annually issues 2000 pages of abstracts of these reports to 500 subscribers in Government, industry, and universities. Much of this information is of direct interest to industry. For example, termite damage to wood is estimated to cost $40 million annually, and a railroad using a million ties could save $150,000 by increasing the life of these ties by only one year. Losses resulting from marine borer attack on wooden structures amount to $50 million annually; prevention of only a fraction of this damage could mean substantial savings for companies owning docks or waterfront installations.

Efforts to overcome deterioration include utilization or development of

new resistant materials, such as nylon or glass fibers, to decrease fungus damage control of the immediate environment, such as air-conditioned storage, or resistant coatings for pipelines carrying fuel; of preservatives or agents which protect against, for instance, shrinkage, fire, rodents, or fungus; and chemical modification of old materials, such as treatment of cotton to provide mildew resistance.

Bacteria Cause Stain on Iron and Steel

➤ RECENT research has shown that bacteria can cause stains on ferrous metal surfaces.

A. W. Lindert, research expert for the Standard Oil Company of Indiana, told a meeting of the Milwaukee chapter of the American Society of Lubrication Engineers, that bacteria can thrive on oil as well as dirt. They are in the water which forms part of the soluble oil emulsion used to cool metal being worked in machine shops.

The emulsion is also designed to prevent rust. The oil does that. But because bacteria can live in the water and form organic acids from the hydrocarbons in the oil, the emulsion was found to be having the very effect it was designed to avoid. The acids ate into the metal, staining it so that only more machining would remove the stains.

The remedy is to change the emulsion frequently as the operation nears the end, to tailor the oil to the hardness of the water, and to provide an extra emulsion bath for the finished part.

Air Agitation Helps Extinguish Fires

➤ ORDINARY air is the newest aid in controling fires in oil tanks. This air is forced into the bottom of the tank and, rising to the surface, causes agitation of the contents which brings cold oil from lower layers to the burning surface to decrease vapors feeding combustion.

The ordinary foams used in fire-fighting do the rest of the job. The job is easy because there is no slop-over, frothing and expansion of the hot oil layer at the top. In a test made, a tank holding blazing crude oil was under control in 45 seconds and completely extinguished in five minutes by firemen applying foam at close range.

One of the practical aspects of the plan is that no intricate or costly equipment is needed. The air is pumped into the tanks through the pipes that are already there, installed to draw off water that has collected or to draw off oil. Readily available air and a pump capable of producing about six pounds of pressure will do the job.

This process was developed by J. L. Risinger of the Socony-Vacuum Oil Company. It has been successfully used in a tank of 100,000 gallons of flaming kerosene, extinguishing the fire in five seconds. The method has been applied only to oil tanks so far, but it is expected to be equally effective when used on tankers at sea.

New Wrinkles in Metallurgy
New Materials for Many Uses

Recent Chemical Inventions

Send twenty-five cents in money order, coin or Patent Office coupon to the Commissioner of Patents, Washington 25, D. C., for each patent desired, ordering by patent number.

Forgeable Red Brass

➤ Red brass, capable of being hot-worked, that is, rolled, forged and extruded, will now be available to replace the less desirable yellow brass in applications where the metal must be hot-worked or cast for such ornamental work as hardware and window frames in buildings. The reddish color is in high favor. Yellow brass is objectionable, particularly when used in combination with red bronze.

This new aloy provides a brass that has a satisfactory red bronze color in both the cast and the hot-worked conditions. In addition to being suitable for casting and forging, it can be used for wrought parts in combination with parts cast from red bronze.

This red brass is about 53% copper and 42% zinc, the rest being small quantities of lead, aluminum, manganese, silicon and iron. Patent 2,577,426 was awarded to William E. McCullough, Detroit, for the invention. Rights have been assigned to Bohn Aluminum & Brass Corporation of the same city.

Improved Explosive

➤ An improved explosive containing expanded vermiculite instead of organic low density combustibles brought Austin Maurice Cummings, Woodbury, N. J., patent 2,577,110 with rights assigned to the DuPont Company of Wilmington. Using this mica-like mineral, which has been greatly expanded by heat, provides density control without unfavorable effect on the flammability and safety properties. The product is a high velocity detonating explosive of the non-nitroglycerine type. It is about 60% ammonium nitrate, 23% sodium nitrate and 4% vermiculite, the rest being paraffin and dinitrotoluene.

Printing Paper

➤ Glossy printing paper for the reproduction of fine half-tone cuts is claimed as an improved mineral or pigment coated paper having high brightness, high gloss and good affinity for printing inks. It uses for a binder to fix the clay, talc or other mineral surface, a styrene-maleic anhydride. After drying and calendering, the coated paper stock has a smooth and continuous surface. Inventor is George E. Niles, Winchester, Mass. Patent 2,577,614 was his award. Monsanto Chemical Company, St. Louis, Mo., has acquired the patent rights.

Storing Apples

➤ Apples in storage retain their natural condition over many months without loss of flavor, aroma, firmness and general appearance with a packing method which brought Adam J.

Borck, Canon City, Colo., patent 2,576,919. The method involves placing the apples in boxes in layers between sheets of relatively thick moisture absorbent paper which is impregnated with a solution of salt and honey. This solution has been treated by contact with carbon. The inventor claims that there is a vapor interchange between individual apples and the paper due to the normal breathing of the fruit.

Cutter for Dry Ice

➤ THE DIFFICULT and somewhat dangerous job of cutting the 10-inch cubes of dry ice, solidified carbon dioxide, that come from the manufacturing machine into small cubes for sale and use is simplified with an electrical cutter which brought patent 2,577,745 to Lee Foster, Berwyn, Ill. The old method uses a saw, and it is slow, laborious and wasteful.

The new cutter is a frame holding parallel electric resistance wires across it. The wires are heated with an electric current. The frame, with its wires heated, is placed on top of the dry-ice cube. The wires melt their way into and through the solid block of dry ice. No force but gravity is required.

Better Magnets

➤ BETTER permanent magnets of the so-called Alnico type, which contain iron, aluminum, nickel and cobalt and have unusual strength, are promised with an improved casting process which has been awarded a patent by the government.

The process results in markedly improved magnetic directional properties, it is claimed. Such properties mean that the magnetic force is greater in one direction than in a direction at right angles. They have been obtained in the past by a heat treatment in a magnetic field.

In the new method the magnets are cast in molds or cavities in which heat loss through the sides during solidification is held to a minimum. The heat is removed from one end by means of a metal chill in direct contact with the molten alloy. This causes lengthwise extending crystals to form in the solidifying metal mass.

Inventor is Dolph G. P. Ebeling, Troy, N. Y. His award is patent 2,578,407. Rights have been assigned to General Electric Company, Schenectady, N. Y.

Coatings for Aluminum

➤ AN IMPROVED method of producing corrosion-resistant oxide coatings of aluminum and its alloys brought patent 2,578,400 to Charles C. Cohn, Elkins Park, Pa. It would seem to be a combination of two older processes, neither of which alone gives a satisfactory coating for all purposes. The first treatment in this process is in an electrolytic bath containing sulfuric or other acid. This is followed by treatment in another bath containing chromic acid, and free from sulfuric acid.

Nitrates From Air

➤ AN IMPROVED process for making nitrates for fertilizers and explosives from the nitrogen in the atmosphere was awarded a patent by the government. It is a development by scientists at the University of Wisconsin and has been assigned to the Wisconsin Alumni Research Foundation.

The patent, number 2,578,674, was issued to Farrington Daniels, Madison, Wis., William G. Hendrickson, San Jose, Calif., and Elton Gordon Foster, Wilmington, Del. The principal feature of the invention is the method of recovering oxides of nitrogen from gaseous mixtures containing them. These gaseous mixtures are made by the so-called arc process of fixing atmospheric nitrogen and more particularly, by what is known as the Wisconsin thermal process of nitrogen fixation.

This process for the recovery of nitrogen dioxide from a gas mixture containing nitrogen, oxygen and a small amount of nitrogen dioxide comprises passing the mixture in a dried and cooled state through a mass of adsorbent silicon dioxide. This results in an adsorption of the nitrogen dioxide in the silicon dioxide particles from which it is later separated.

American Inventors' Patents in 1951

➤ THE U. S. Patent Office found 1951 a busy year, issuing 44,356 patents or 1,284 more than during 1950. The weekly average output was 853, while for 1950 it was 828. The actual number issued each week hovered close to the weekly average for the year.

Patents for new chemical compounds and improved processes for making old chemicals stand high in number, again indicating America's leadership in the chemical field. Notable among these chemicals are pharmaceuticals, dyestuffs, insecticides, fertilizers, fungicides, explosives, detergents, fuels, synthetic fibers, weed-killers, water softeners and many others for use in the industries, the household or on the farm.

Metallurgists have received many patents during the year, particularly for new alloys, including some better able to withstand the high temperatures in gas turbine and jet engines, others with increased strength or hardness, and several assured longer life because better able to resist corrosion.

Substitute metals may come into wider usage, replacing common metals now in short supply, because of new processes of treatment discovered. For instance, aluminum containing a small amount of boron has the necessary strength to replace copper for electrical wiring. Magnesium containing three of the so-called rare earth metals has strength and durability and will find many applications. The alloying metals are cerium, neodymium and praseodymium.

During 1951, as in other years, many patents have been issued to individual inventors but rights are assigned to some department or other of the United States Government. For the most part these inventors are working for the government directly or in research laboratories under specific contract with the government. Manufacturers throughout the country can usually get a license to make the items so patented without payment of royalties. In a recent government publication available from the U. S. Government Printing Office for one dollar is a list of 2,339 patents owned by the government which American businessmen can use without charge. Its title is Government-Owned Inventions for Free Use.

Proudly Presented

➤ CITY GAS made from almost any hydrocarbon, such as light oil, propane or butane, comes from a new plant at Rochester, N. Y. It uses the Koppers-Hasche process of either thermal or catalytic reforming. The process is described in the winter 1951 issue of Koppers Magazine, Pittsburgh 19, Pa.

➤ VINYL and other plastics are featured in the recent issue of Bakelite Review, 30 East 42nd St., New York 17, N. Y. Floors, trees, dental plates, needle threaders and propaganda balloons are among the uses described.

➤ A PROJECTION screen for showing slides or movies without need to darken the room is announced in three sizes by Radiant Manufacturing Corp., 2627 W. Roosevelt Road, Chicago 8, Ill.

➤ NORTH AMERICAN Philips Co. announces a new catalog of their equipment for X-ray Diffraction and Geiger-Counter X-ray Spectrometric research. Copies are available from their Research and Control Instruments Division, 750 South Fulton Avenue, Mount Vernon, N. Y.

➤ THE SOLVAY Process Division of the Allied Chemical and Dye Corporation, long producers of inorganic chemicals, will branch out into the field of organics with the construction of a plant to manufacture ethylene glycol and ethylene oxide near Orange, Texas.

➤ Two RESEARCH bulletins, "Sulfur Poisoning of Nickel Catalysts" and "Expansion Behavior of Coal During Carbonization," mark the new series of these publications by the Institute of Gas Technology, 17 West 34th St., Chicago 16, Ill. Sixteen bulletins, in all, are in process of preparation and publication.

➤ INFORMATION about the uses of carbon black and a description of application of television to industrial use appear in Witcombings, house organ of the Witco Chemical Co., 295 Madison Ave., New York 17, N. Y.

➤ FLUID hydroforming, for improving the octane rating of napthas, and production of Kel-F, fluorocarbon-type plastic, are described in the latest issue of Kelloggram and illustrated with photographs of the laboratories of the M. W. Kellogg Co., 225 Broadway, New York 7, N. Y.

➤ NITROFURANS, used in both veterinary and human medicine to control infection, will be produced on a large scale by the Norwich Pharmacal Co. The drug is made from furfural, produced from waste cereal products by the Quaker Oats Co. Announcement of the new quantities of the drug available comes from Doremus and Co., 120 Broadway, New York City.

➤ PROPERTIES and uses of Hercules CMC Cellulose Gum are comprehensively reviewed in a 20-page booklet published by the Cellulose Products Department of the Hercules Powder Co., Wilmington, Del. A bibliography of papers describing applications of CMC in many industries is a useful feature of this bulletin.